PRACTICAL ENGINEER

Trade-mark, Reg. U. S. Pat. Off.

SEMI-MONTHLY

VOL. XXI. CHICAGO, AUGUST 15, 1917 No. 16

Heating and Ventilation at Harrison Tech

STEAM FOR HEATING CHICAGO'S LARGEST VOCATIONAL INSTITUTION GENERATED AT HIGH PRESSURE; ALL PUMPING EQUIPMENT UNDER AUTOMATIC CONTROL AND INTERCONNECTED TO PROVIDE FLEXIBILITY OF OPERATION

"OH, MR. SPAIN, could you please unlock this door so that I——?"

"Oh, Mr. Spain! Can you please turn on these lights for——?"

"Mr. Spain, would you please see if this thermometer is correct?"

"Oh, Mr. Spain——," but what is the use of going any further? Thus it is in addition to the many trials and tribulations attending his regular duties, that the practically inexhaustible good nature of J. J. Spain, chief engineer of the Carter H. Harrison Technical High School, Chicago, is sorely tried. Of all the busy men around Harrison Tech. he is without doubt the busiest, but spite of this fact we found him not too busy to show us about the heating plant connected with this institution and of which he has charge.

The exterior of the main building housing this school is of the Corinthian type of architecture; but three stories high, it has overall dimensions of approximately

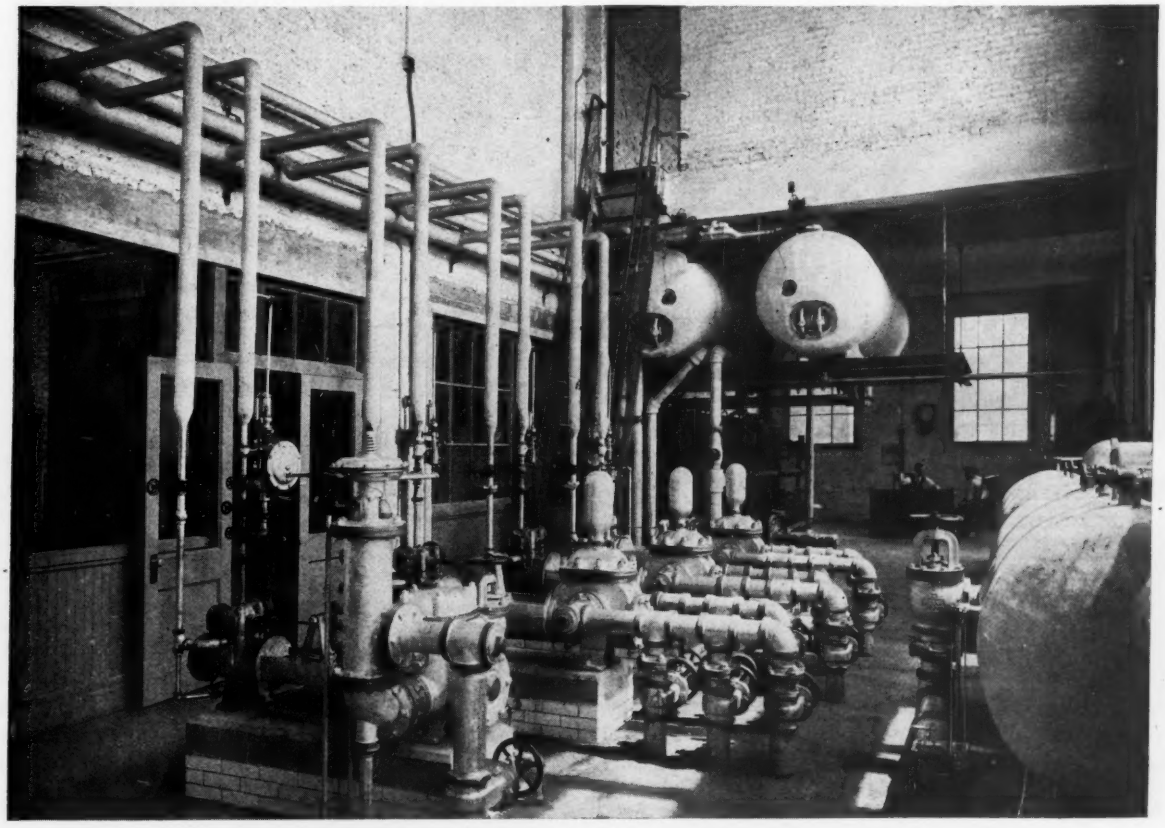


FIG. 1. PUMP ROOM OF HARRISON TECHNICAL HIGH SCHOOL

352 ft. by 287 ft. and occupies the western end of that tract of ground bounded by Marshall Boulevard on the west, So. California Ave. on the east, 23rd Place on the north and 24th Boulevard on the south. Connected to this along 23rd Place is a wing 225 ft. long and 65 ft. wide, in which are the manual training departments and the heating plant. Brick, marble, concrete and steel are the materials of construction used throughout, thus making the structure practically fireproof. The outside is of a light tan color.

Light and Power Supply

Although original plans apparently provided for an engine room, no electric or power generating equipment has up to the present time been installed. Current for electric light and power is obtained from the local public service company over 2300-v. 3-phase alternating-current lines feeding an individual bank of transformers located in a brick vault on the second floor of the plant and from there it is fed to a sheet-steel encased black slate switchboard, whence it is distributed over a 3-wire system to the various floors and departments. Motors are supplied at 220 v. and lights at 110 v. The connected lighting load approximates 95 kw., while the power requirements call for an additional 120 kw. for the operation of motors distributed as follows:

Service	Horsepower
Ventilating and heating fans	126
Machine shop	35
Electric construction shop	35
Forge room	25
Foundry	12
Chipping room	10
Printing department	5
Electrical laboratory	5
Miscellaneous	10
Total connected horsepower	293

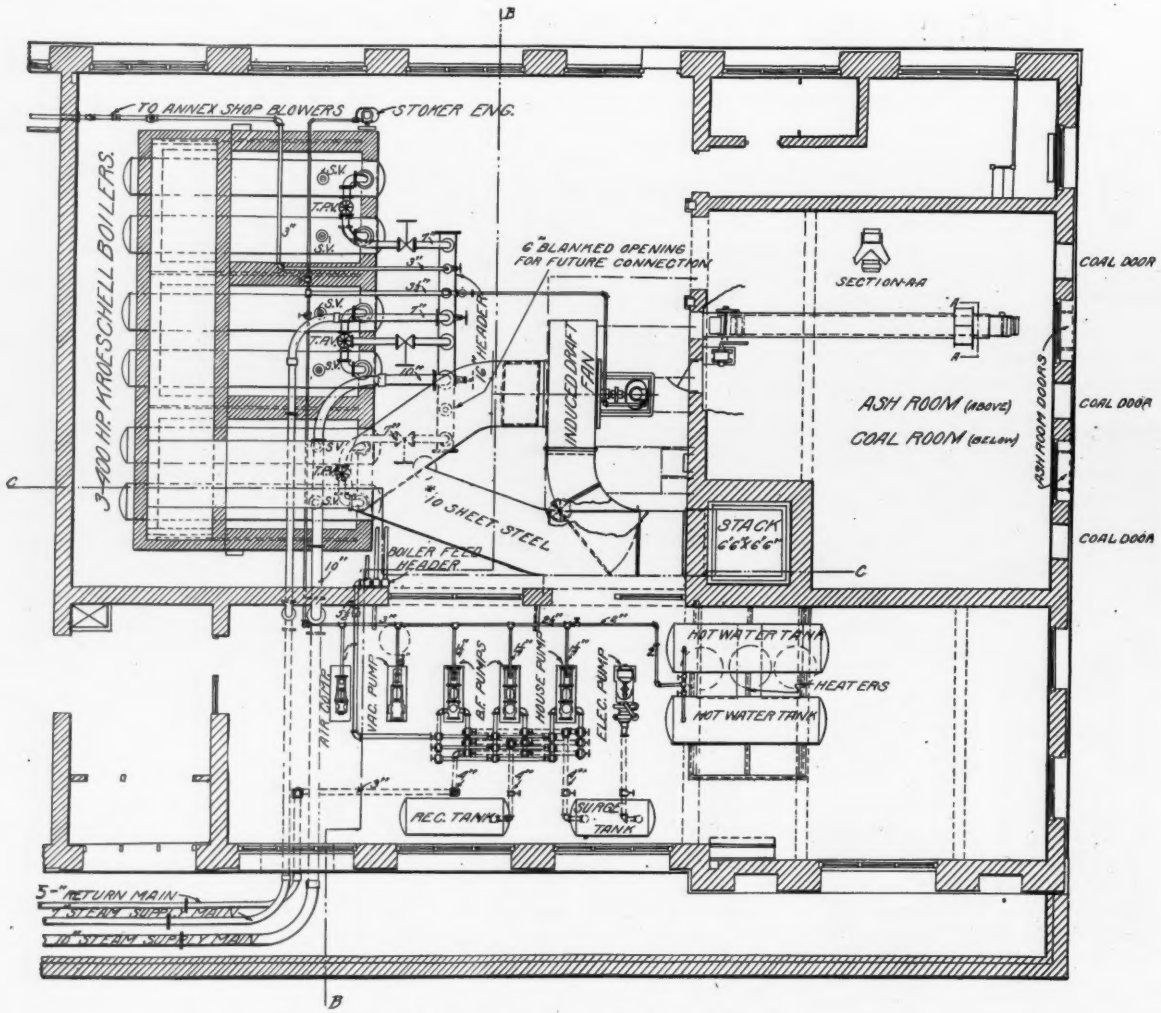


FIG. 2. PLAN OF BOILER AND PUMP ROOMS

Fan motors are mounted on hardwood frame bases and where these machines are of the rotor-wound type cast-grid resistances enclosed in angle-iron frames and drum controllers are provided. Protection is afforded by means of 3-pole type W, ITE circuit breakers with overload time-limit and no-voltage release. Circuit breakers and drum controllers are mounted on slate panels supported by angle iron frames. Other motors such as

used in the various shops and when rated at 5 hp. and more are equipped with oil break compensator starters provided with fuse block and fuses placed in an iron box secured to the top of the starter case.

Specifications of motors installed required a guaranteed power factor of no less than 84 per cent at full load and an efficiency of not less than 87 per cent for the 15 and 20-hp. machines and not less than 84 per cent for the 3 and 5-hp. units.

All wiring is carried in iron conduit imbedded in concrete and is of a size such as to withstand considerably greater load than is being called for at present, thereby rendering the system capable of caring for added future requirements.

Steam Generating Equipment

Boiler room, coal storage and ash receiving chamber occupy the north section of that portion of the building housing the plant and are separated from the pump room by means of an 18-in. party wall.

Entering the boiler room from the 23rd Place side, the visitor finds at his right, as shown in Fig. 4, the three steam generating units which are supported by

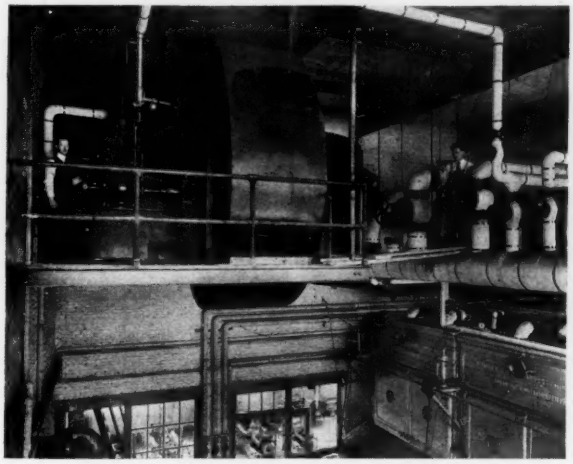


FIG. 3. INDUCED DRAFT APPARATUS AND MAIN STEAM HEADER

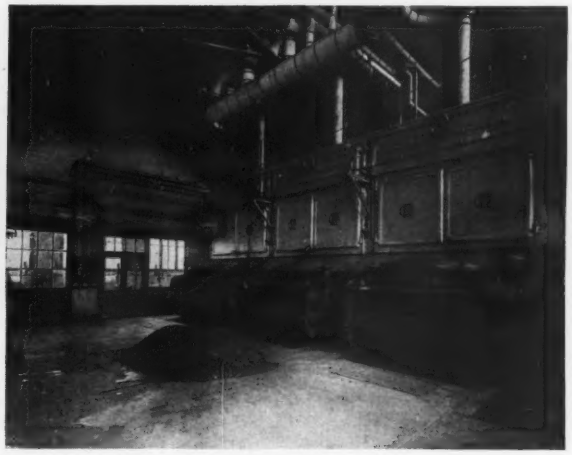


FIG. 4. BOILER ROOM OF HARRISON TECHNICAL HIGH SCHOOL

I-beam construction with columns resting on concrete foundation footings extending 10 ft. below the floor line of the boiler room. Each of the boilers which are of the water-tube type and which were built by Kroeschell Bros. have according to original specifications approximately 4047 sq. ft. of heating surface 75 per cent of which is provided by the tubes and are each equipped with traveling chain grate stokers of Laclede-Christy make having 80 sq. ft. of effective area.

All setting walls exposed to the heat of the furnaces in front of the bridge wall are lined with a 9-in. course of fire brick laid in No. 1 fire clay and mortar while the linings to the rear of the bridge wall and extending to the level of the ash pit floor consist of a 4½-in. course of fire brick. Ash pit and combustion chamber floors are paved with sewer brick and fire brick, respectively, laid on edge and well grouted.

Boiler smoke openings connect with a double 6-ft. 6-in. square breeching built up of No. 10 material reinforced by 2-in. angle irons and of Y-form. One of the legs of this breeching leads directly to the stack, while in the other is placed by a 48 by 96-in. Garden City Blower Co. induced draft fan driven by a 20-hp. phase-wound variable speed, non-reversible motor capable of creating a draft of 1¼ in. of water in the main section of the breeching at the stack inlet. Dampers operated by hand wheels from below allow cutting out of that branch of the breeching not in use.

Leaving the grates, ashes and clinkers fall into a pit below from where they are removed by a Girtanner-Daviess steam jet ash conveyor to a 50-ton ash receiving chamber located directly above the coal storage. Chutes and attached swinging spouts leading to the outside of the building allow the emptying of this chamber at frequent intervals.

From each boiler 7-in. mains fitted with Crane triple-duty emergency valves of vertical type and Crane extra-heavy angle valves of like size, connect with a 16-in. extra heavy header carried along the boiler fronts as indicated in Figs. 2, 3 and 4.

In turn, the various branches supplying the heating system and pumps are fed by this header, these branches being attached to the header by means of steel flanged saddle nozzles of sizes corresponding to those of the connecting pipes. The number, size and nature of service supplied by these distributing branches are as follows:

1 10-in. for heating chambers.
1 7-in. for heating chambers.
1 3-in. for heating chambers.
1 4-in. for heating engines and pumps.
1 6-in. with blank flanges for possible future service.

Steam is generated and transmitted at a pressure of 110 lb. gage, although secondary distribution is maintained at 2 lb. accomplished by reducing the high pressure by means of reducing valves at the various points of distribution. Returns are handled under a vacuum of about 8 in. created by a 6 by 8 by 12-in. Blake-Knowles self-governed vacuum pump fitted with an automatic controller and a 6-in. condensing chamber attached to the suction. This condensing chamber is in turn provided with a ½-in. galvanized iron water supply pipe

carrying two valves, one at the chamber and the other at the water supply line where this branch is taken off.

Water of condensation is returned from the heating system through a 5-in. main which discharges into a receiving tank located in the pump room and having a diameter of 36-in. and a length of 8 ft. A bypass arrangement of the piping allows of this tank being cut out of service without interfering with the operation of the heating system.

In the Pump Room

In addition to the vacuum pump and the returns receiving tank the pump room contains 2 Blake-Knowles boiler feeders each having 10-in. steam cylinders, 6-in. water cylinders and 12-in. stroke, one Chicago Pump Co. 10 by 6 by 12-in. house service pump, one 120-gal. per minute centrifugal house supply pump operated by a 7½-hp. electric motor, for use when the steam-driven unit cannot be operated, and a No. 19 Marsh air compressor having an 8-in. steam cylinder, a 6-in. air cylinder and an 8-in. stroke. This compressor which is employed in connection with the heat regulation system has a capacity of 15 cu. ft. of air per minute and is provided with an automatic governor which regulates the speed of the machine dependent upon the degree of pressure in the air receiving tank, which with a pressure of 100 lb. gage on the boilers is normally maintained at 75 lb. The tank used in connection with this machine has a diameter of 24 in., a length of 5 ft. and is constructed to withstand a pressure of 150 lb.; it is provided with a 1-in. pop safety valve set to release at a pressure of 75 lb.

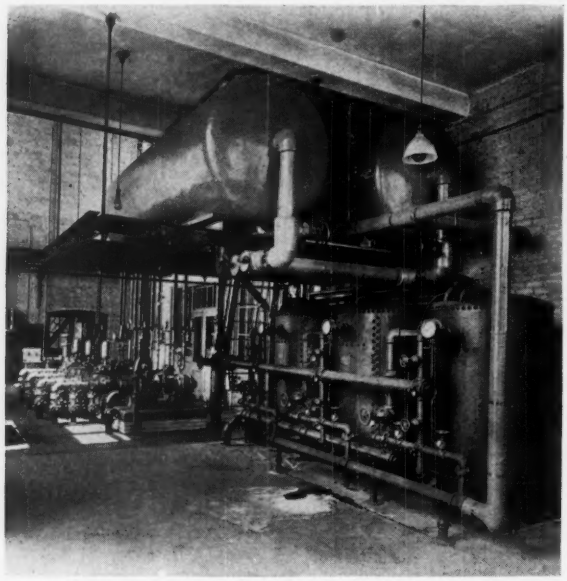


FIG. 5. WATER HEATERS AND FILTERS

All of the pumps are under automatic control and together with the two hot water tanks illustrated in Figs. 2 and 5 are supplied with steam through the medium of an independent header made up of 3½, 3, 2½ and 2-in. sections.

Interconnection of suction and discharge lines of the various pumps provides much flexibility of operating, allowing house, vacuum and boiler feed units to be employed interchangeably for service other than planned and as conditions or requirements may demand.

Steam exhaust pipes from pumps and air compressors are also cross-connected in such a manner as to allow the exhaust from these units to furnish steam to the low-pressure heating main.

Hot Water Supply

Institutions of this type and size require considerable quantities of hot water and to supply this need there have been installed in the pump room two heaters, each having a diameter of 48 in. and a length of 12 ft. and made up of 5/16-in. thick tank steel.

The heating unit contained therein consists of a flat coil of 2-in. iron pipe having a length such as to furnish approximately 40 sq. ft. of heating surface. The steam supply line is fitted with a siphon tank regulator of American Radiator Co. make, while the returns from this coil are cared for by a trap and bypass, the discharge from which enters the top of the receiving tank used for the returns from the heating system. Each of these heaters has a capacity of about 1200 gal. of water per hour heated to a temperature of 180 deg. F.

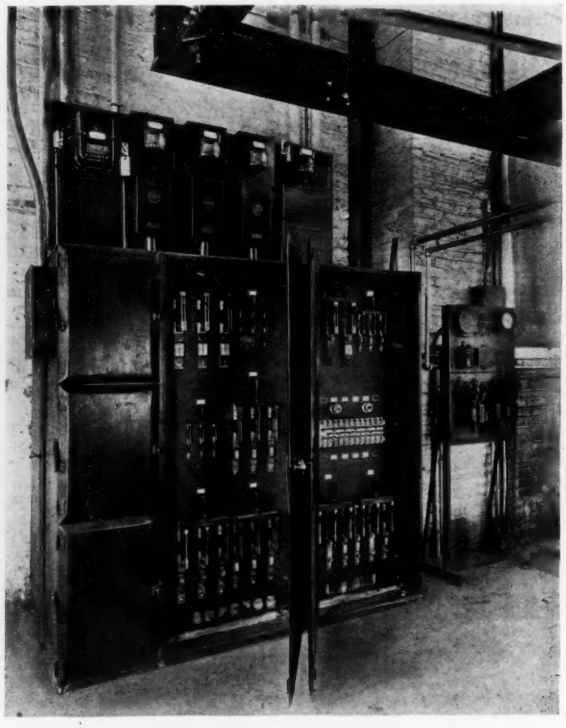


FIG. 6. MAIN ELECTRICAL CONTROL CABINET

Raw Water Supply

Water used for all purposes is taken from the city mains which deliver it to a surge tank having a diameter of 30 in. and a length of 6 ft. and built up of 5/16-in. tank steel. The suctions of all pumps as indicated by Fig. 2 connect to this tank by means of 4-in. tie lines. House service is had from a 48-in. by 12-ft. tank placed in the attic of the building and receiving its supply from the house pumps.

Indirect Heating Equipment

For the greater part, this institution is heated by the indirect system. Centrally located in the 225 by 65-ft., 2-story wing housing the manual training department, is a double blower set consisting of 2 No. 7 Sirocco motor-driven fans having a combined capacity of 19,275 cu. ft. of air per minute, and which forces fresh air taken from the outside through tempering coils, each of which is made up of 5 coil radiators. The east chamber of this set is provided with 938.5 sq. ft. of radiating surface, while the west chamber has 833 sq. ft. of radiating surface.

Steam for these coils is taken from a 6-in. low-pressure main receiving its supply through a 3 by 6-in.

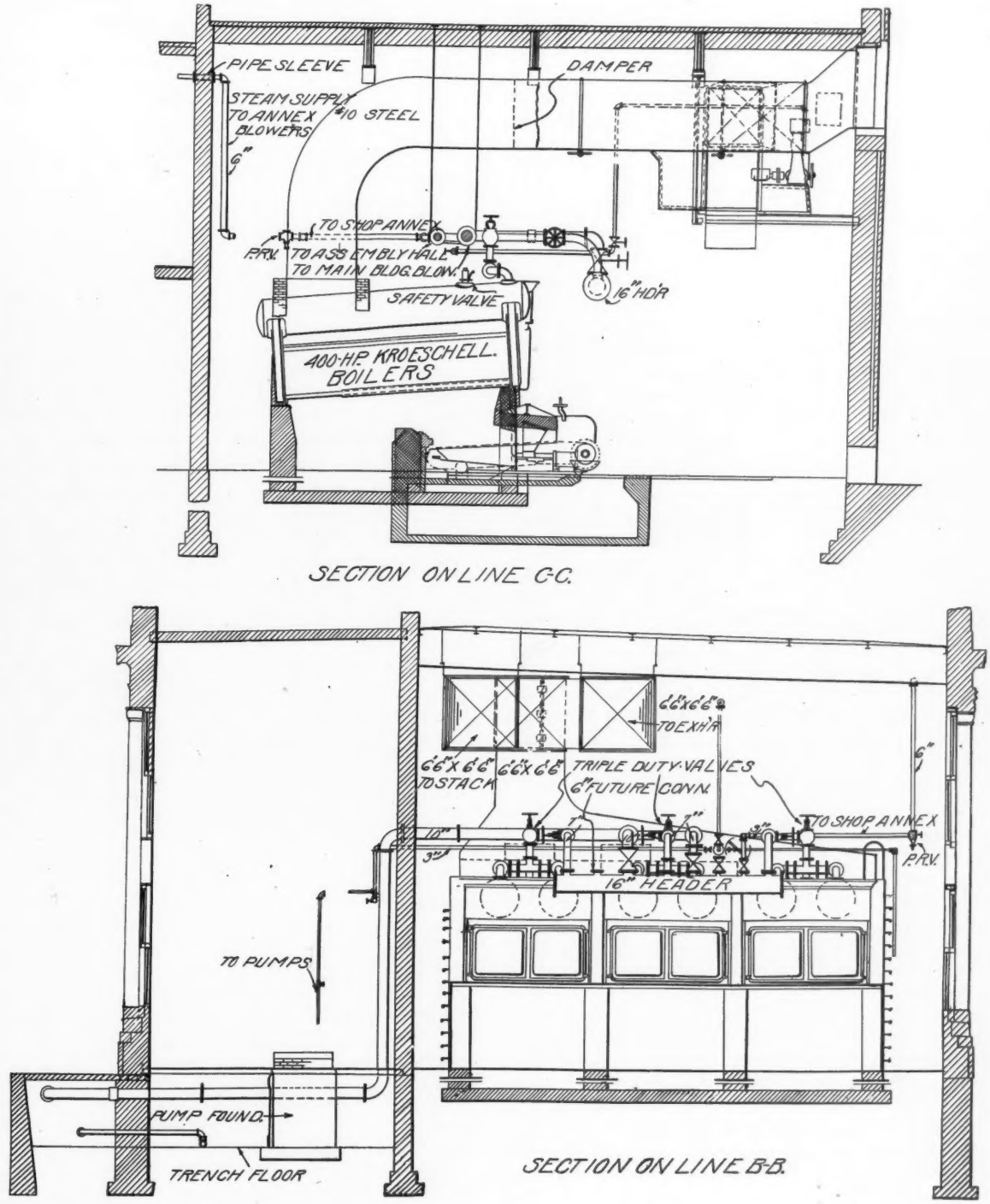


FIG. 7. SECTIONS THROUGH BOILER ROOM

Crane pressure reducing valve connected to the main header in the boiler room by means of a 3-in. tie line. Returns are cared for by a 2-in. branch discharging into the 5-in. main return line.

Class rooms, shops, offices, lavatories, etc., on the first floor of the main building are heated by means of units numbers 1, 2, 3 and 4, each of which is made up of a motor-driven 60 by 114-in. Sirocco blower capable of delivering an average of 43,000 cu. ft. of air per minute. Each of the tempering chambers of these sets contains 4 5-ft. 8-in. radiators with a combined radiating surface for both right and left sides of 1964 sq. ft.; the warm air chambers have each 6 sets of 5-ft. 8-in. coils with combined radiating surfaces of 2946 sq. ft.

Blowers 5, 6 and 7 are employed for use in heating the assembly hall and shops respectively. The former consists of a No. 15 Sirocco fan delivering 51,200 cu. ft. of air per minute, while each of the others is a 27 by 54-in. machine having a maximum capacity of about 11,000 cu. ft. of air per minute. Chambers 6 and 7 are provided with tempering coils, each having 5 4-ft. 8-in. radiators with 1010 sq. ft. of radiating surface.

The warm air coming from these various sets is distributed through galvanized iron ducts.

Heat regulation is accomplished by means of thermostats used in conjunction with air operated dampers which allow mixing of air of two different temperatures at point of distribution in warm air distributing chambers. Warm air is admitted only until the room temperature has reached 68 deg. F., when the dampers begin to assume an intermediate position, such as will maintain the temperature within 2 deg. of that desired. Not until the temperature of the room rises above 68 deg. F. will the warm air be cut off entirely.

Detailed data relative to size, capacity and horsepower requirements of the various blowers employed in connection with the heating system follows:

Chamber No.	Size of blower	Cu. Ft. of Air per Min.	R.p.m.	Horsepower of Motor
1	60 by 114 in.	46,125	120	15
2	60 by 114 in.	45,726	120	15
3	60 by 114 in.	42,293	110	15
4	60 by 114 in.	43,861	113	15
5	Sir. No. 15	51,200	112	20
6	27 by 54 in.	11,145	290	5
7	27 by 54 in.	11,000	290	5
8	Sir. No. 7	10,250	218	3
9	Sir. No. 7	9,025	195	3

Ventilation

Proper circulation of air is maintained by means of a system of ventilating ducts terminating in the suction of 2 exhaust fans located in the attic of the main building. One of these fans is provided with an 18 by 36-in. wheel, while the other has a 15 by 30-in. wheel.

Heine Boiler Construction

Details of Drum and Water Leg Design; Location of Superheater; Forms of Baffle Tiling

CONSTRUCTION of the Heine boiler may be divided into 3 main parts—the shell, waterlegs and tubes. Either one or 2 drums are provided, of diameter usually from 30 to 48 in., and in length from 17 to 22 ft., depending upon the size. A flanged-in reinforced manhole is provided in the rear head, and the main steam outlet is cut at the top of shell near the front end, the steam tee being attached to a steel saddle riveted to the shell.

In the bottom of the shell near each end is cut the throat opening for the internal connection to the waterleg. To compensate for the metal cut away, forged steel throat stays, bridging these openings are riveted on when the waterlegs are attached, as shown in Fig. 1. Inside and near the bottom of the shell and parallel thereto is fastened a sheet-iron mud drum which is entirely closed with the exception of a small opening at the top near the front end. Passing through the top of the shell, the feed pipe enters the front end of the mud drum near the bottom, while the blowoff connection which passes through the rear head of the shell connects with the back end of the mud drum near the bottom.

Over the throat opening at the front end, slanting upward toward the rear, is placed a sheet-iron deflection plate, closely fitted to the front head and to that portion of the circumferences of the shell with which it comes in contact. It extends several feet back of the throat opening. Inside of the shell, just beneath the steam opening is fastened the dry pan which is a shallow sheet-iron box with a large number of perforations in the sides.

To each side of the exterior of the shell is attached a series of hooks, as shown in Fig. 2, which support the tile bars, the function of which is to carry one edge of the plates covering the opening between the drum and side walls, except at the rear where the opening is allowed for the gases.

Waterleg Construction

The waterlegs are made of 2 plates termed respectively the tube sheet and handhole sheet, which are flanged and joined together by a butt strap. Being flat surfaces, the waterleg plates require staying to withstand the internal pressure, and for this purpose hollow staybolts of mild steel tubing are employed. These are screwed into tapped holes in the 2 plates, the projecting ends being upset on the outside. Tube holes and handholes are bored to exact diameters and when completed, the waterlegs are riveted to the shell over the throat openings.

Closure of the handholes is effected by means of cast-iron or forged steel plates inserted from the inside and held in position by yokes and bolts bearing on the outside sheet. Figure 3 shows a section through a waterleg with cast-iron handhole plates and yokes in position.

Tubes and Superheater

Between the 2 waterlegs extend the tubes which are

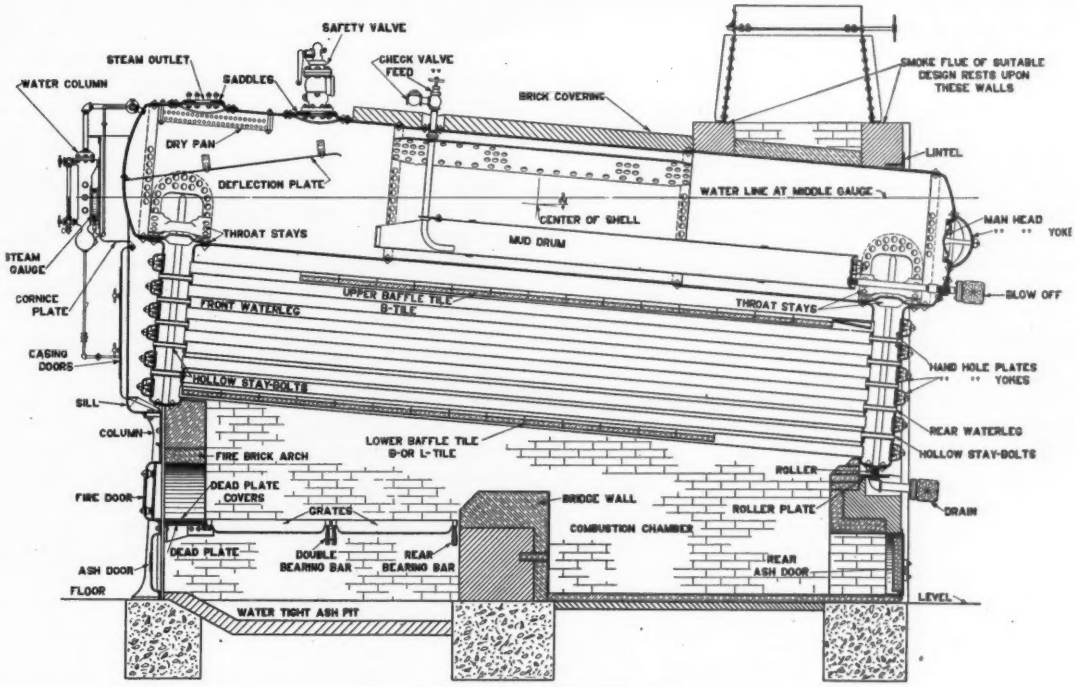


FIG. 1. SECTION OF HEINE BOILER

expanded into the tube sheets and slightly flared to increase the holding power.

In preparing to remove a damaged tube, the handhole plate opposite the tube to be cut is removed, also the plate above or below, and a ripper started at an angle with the tube. The ripper is a simple tool resembling a chisel, about 16 in. long, with a blade ¼ in. thick and 1½ in. wide, having a 45-deg. cutting edge. After the tube end is cut it may be collapsed by a round-nosed tool about 16 in. long, known as an oyster knife, or by turning it up with a bar about 3 or 4 ft. in length.

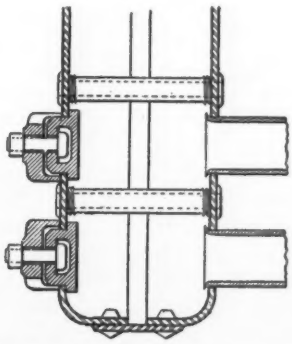


FIG. 3. LOWER PART OF WATERLEG SHOWING HANDHOLE PLATES IN POSITION

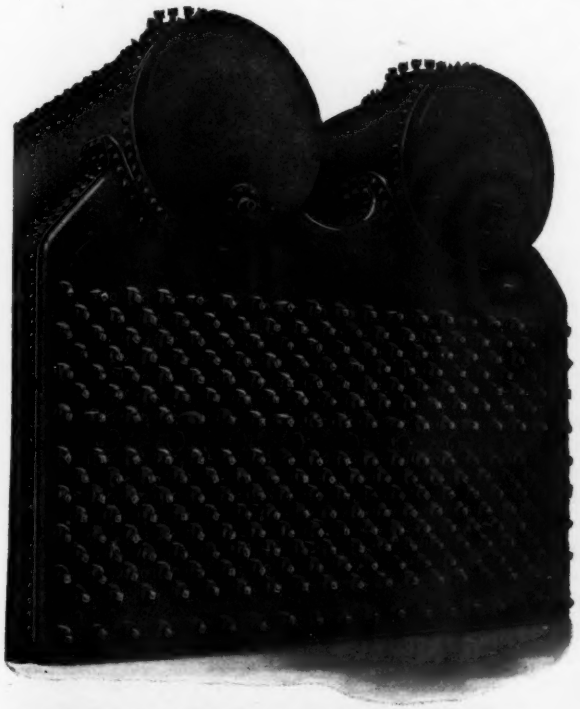


FIG. 2. FRONT WATERLEG OF 2-DRUM 2-PASS BOILER

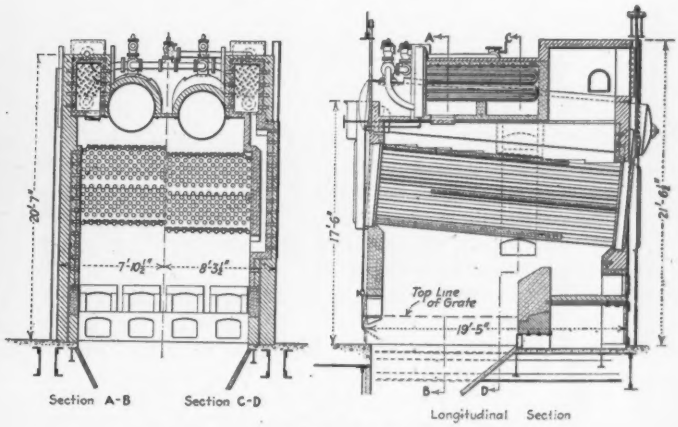


FIG. 4. LOCATION OF SUPERHEATER

In withdrawing a damaged tube located near the bottom, an easy method is to use an ordinary pipe cutter and cut the tube near one end, or if preferred, near the middle. If cut near one end, the short piece can be knocked out with a hammer and the long piece removed by working it from side to side. Should it be one of the upper tubes, the ends should be crimped in, and ordinarily the tube may be pulled through the hole without cutting.

In water-tube boilers, the tubes should extend through the sheet or header not less than ¼ in. and not over ½ in. After inserting a new tube, an ordinary roller or dudgeon expander is employed to fasten the ends, after

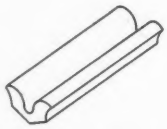


FIG. 5. "B" TILE

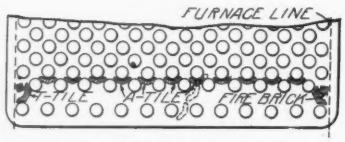


FIG. 6. INSERTING "A" TILE ON SECOND ROW OF TUBES

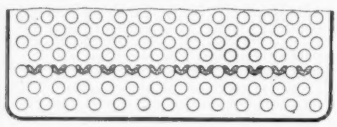


FIG. 7. B-SPACING WITH "B"-TILE

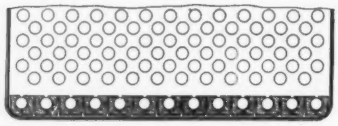


FIG. 8. A-SPACING WITH "L"-TILE

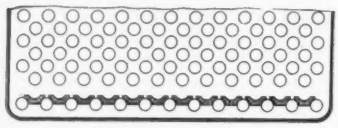


FIG. 9. A-SPACING WITH "T"-TILE

which they are belled out about ⅛ in. larger than the tube seat. This flaring out may be accomplished with a properly designed expander or may be done by driving in a conical plug after the tube has been rolled, following this with a slight rerolling in order to make sure that it has not been loosened.

The superheater consists of 2 sections, one on each side of the drum, each being located above the water line in a firebrick chamber formed as shown in Fig. 4, which is a setting for hand firing with anthracite coal. A flue connecting the chamber directly with the furnace allows a small portion of the furnace gases to flow up the flue, which, after traveling over the superheater tubes, are discharged from the chamber at the end nearest the front header, passing under the boiler drum on the way to the uptake. A damper in the superheater outlet controls the amount of gases flowing over the tubes.

Expanded into rectangular box headers are the 1½-in. superheater tubes, which are bent into a "U" shape. Within the headers are 2 partition plates dividing the superheater box into 3 chambers and causing the steam flow through the tubes in 4 passes. Hollow staybolts in the headers permit of the removal of soot from the superheater tubes, and handhole plates are provided for access to the tube ends.

Setting and Support

When set for service, the Heine boiler inclines downward from the front, 1 in 12. For hand firing, the front end is supported on heavy cast-iron columns, the rear end resting on rollers which in turn bear on cast-iron plates set in the top of the brick wall. If the boiler is to be equipped with a stoker, brackets supported by columns at each side are substituted for the cast-iron columns, or the boiler is suspended from an overhead support. The rear waterleg rests upon rollers which transmit the load to rear supporting columns.

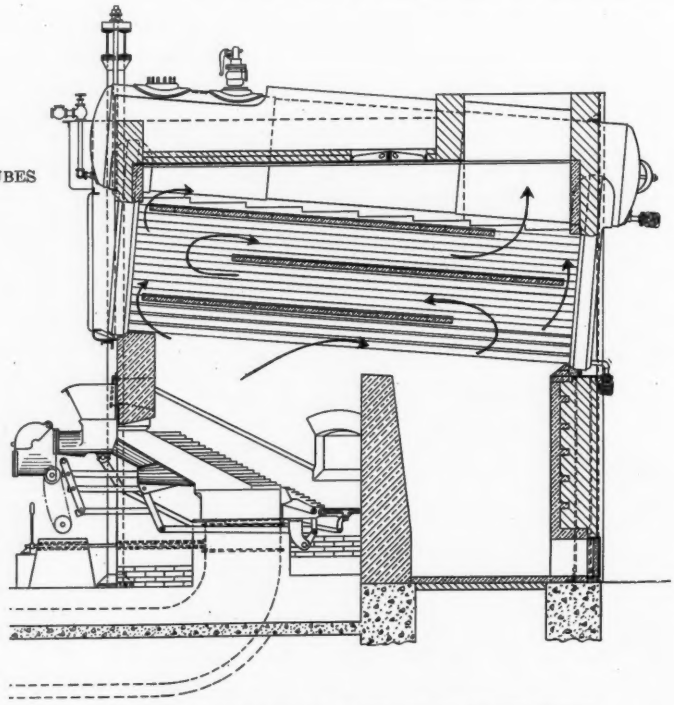


FIG. 10. ARRANGEMENT OF BAFFLING IN 2-PASS HEINE BOILER

Baffles

On the lower row of tubes, extending back within 3 or 4 ft. of the rear end, are placed firebrick baffle tiling, and likewise on the upper row of tubes, extending to within 3 or 4 ft. of the front end. In the larger boilers, a middle baffle is also employed. For hand-fired furnaces and the older forms of stokers under boilers set comparatively low, the T-tile resting upon the lower row of tubes to form the lower baffle, was well adapted. With the introduction, however, of new forms of stokers and

higher settings, furnace conditions were modified and it became desirable to expose, without obstruction, the 2 or 3 lower rows of tubes to the furnace heat. To provide for this condition, the Heine Company designed several new baffle tile, and altered the vertical spacing of the first 3 rows of tubes. The B-tile is the new shape used with this design, which is called the "B" spacing, the old standard design being known as the "A" spacing. Various forms of Heine baffle tile and the tube spacings are shown in Figs. 5, 6, 7, 8 and 9.

It should be understood: (1) That A-tile can be used on all Heine boilers on the second or third rows of tubes; (2) that B-tile can be used on the bottom of all Heine boilers, but on the second or third rows of "B" spaced boilers only; (3) that T-tile can be used only on the bottom row of "A" spaced boilers; (4) that L-tile can be used on the bottom of all Heine boilers.

Figure 6 shows a view of the A-tile in place on the second row from the bottom, the dotted tiles indicating the method of inserting the tile. Owing to the small clearance between the tubes and tile, it is essential that the tube surface be extremely clean. In some cases the tubes may be bent upward slightly by using a bar to spring the tubes apart until the tile can be properly placed. To prevent the A-tile from sliding down the tubes, cast-iron "A-tile retainers" are placed at the end of the tile and made tight with a wedge. To close the spaces between the 2 outside tubes and the wall, T-tiles should be placed as shown, a piece of firebrick holding them in position.

Two-pass boilers have a middle baffle which is formed of B-tile, the tile being introduced through the holes observed near the middle of the waterleg as shown in Fig. 2. These are 5-in. stay tubes through which the tile may be inserted by a man's arm, and by sliding backward or forward, placed in the proper position.

General Operation

Feed water enters the boiler from the top, flows down along the bottom of the mud drum until it becomes heated, then rises and flows out through the opening at the front end of the mud drum to be carried to the rear by the circulation of the water in the boiler. After descending from the shell into the rear waterleg, the water passes to the various tubes, thence upward through the front waterleg to the shell.

In small units the flue gases have a single pass between 2 horizontal baffles, while in larger units intermediate baffles are used, so that the gases make 2 horizontal passes through the boiler either in parallel or series. Dead corners may be reduced in size by leaving openings in the baffles as shown in Fig. 10.

Soot may be blown by means of a Bayer soot blower system, which consists of a series of small nozzles inserted in the staybolts at the rear end of the boiler, with auxiliary sets of nozzles located in the front header. Those staybolts which are not stopped up by the soot blower nozzles are closed by means of wooden or cast-iron plugs.

Spontaneous firing of a pile of coal is generally caused by the absorption of air by the fresh surface of the coal. This generates heat. Thus the finer the coal the greater is the total area of the surfaces by which air may be absorbed and the greater also is its tendency to pack so that the heat formed cannot escape.—Circular No. 4, Uni. of Ill. Experiment Station.

Oil Fuel Installations*

Their Care and Management. By H. J. Geake

Prime essentials for a successful oil-fuel installation are, good material and that material suited to the plant under consideration. The workmanship employed should be the best procurable and made by those having had experience in similar installation. Let simplicity be the keynote as the same rule applies here, as holds good in all other parts, viz.: a multiplicity of parts invites trouble. The whole should be of a rugged build and as near "fool proof" as possible.

All that can be demanded from any burner is that it should atomize efficiently and supply the oil in a continuous and uniform manner. This point carefully considered will help to avoid the pitfall of many freak burners whose claims are, to say the least, delusive.

It is imperative that every burner be fitted with valves of such pattern and design that absolute control of both fuel and spraying medium be obtained at all times.

A type of burner capable of easy installation and operation, and one that in its form of construction embodies easy access to, and renewal of, all parts subjected to wear, and consequent failure, is to be favored.

As it will be found a practical impossibility to prevent the choking of burner tips, due to the foreign substances present in the oil, and these substances will be found to pass through both the suction and pressure strainers, it can readily be seen that the burner that can be rapidly overhauled and replaced will make for efficiency and economical operation.

It will be found advantageous to pre-heat the oil by some simple means, as this will overcome to a great extent the viscosity and render the atomizing process much assistance.

There are many advocates for air as an atomizing medium and many for steam. In a stationary plant it is the usual practice to install steam atomizing burners as by so doing an expensive compressor set is dispensed with, the total amount of steam used for atomization amounts to from 2 to 5 per cent of the evaporated feed, according to the care and watchfulness bestowed upon operating.

A few fundamental principles considered carefully and borne in mind will materially help in the successful and economical operation.

Experiments have shown that in the furnace of an externally fired boiler the temperature is approximately 2500 to 3000 deg. F.

Now it can clearly be seen that any material (relatively) cooler than these temperatures has the direct influence to retard combustion by chilling the gases below ignition point. Steam at a gage pressure of 100 lb. is at the temperature of 337 deg. F., while at 150 lb. per sq. in. its increase is to 365 deg. F. While with a moderate fire a burner in close proximity to the sheets may successfully consume fuel without smoke being formed, the same burner when called upon to do even its rated load under ordinary working conditions will in all probability smoke heavily; this condition being due principally to the gas being chilled and the unconsumed carbon passing off in the form of smoke.

---

*From a paper read before the Victoria Lodge of the B. C. Association of Stationary Engineers.

Hence, it must be apparent to all who give this subject any consideration that the time factor is one of utmost importance. Thus it necessarily follows that the large combustion space or chamber is essential so that the volatile gases of the fuel may be mixed in their proper chemical proportions to insure economical combustion. Lack of attention to air supply control has been the means of many plants which otherwise were well equipped and able to generate power economically, being condemned as unfit. The very fact that oil is a volatile fuel burning without any ash or residue to restrict the draft openings should be taken into account in air admission.

As is well known, all the air (in a leaky setting) is not admitted through the ashpit or other orifices made specially for that function, but a large portion is caused by infiltration through cracks. In many cases a saving of 10 per cent of fuel may be accomplished by carefully calking and stopping all possible air leaks, a simple matter in itself, but important when taken as an adjunct to economy.

Another feature that has a great bearing as a factor of economy and continuity of service is that sufficient straining media be incorporated in the installation. Oil, being obtained from the lower strata of the earth, of necessity carries in suspension in the bulk of the oil more or less foreign substances such as sand, grit, water, etc. If a generous storage is provided, little or no trouble will be encountered from this source.

By placing the suction pipe from the tank a few inches above the bottom of the tank sufficient room may thus be provided for the water separation, and by substituting a T in place of the customary ell on the vent pipe from the tank a ready means is thus provided to insert a ½ or ¾-in. pipe to the bottom of tank where (owing to its specific gravity) the water will settle; this pipe being connected to a pump the water problem is thus easily overcome. As to the sand and grit held in suspension, the suction side may be protected by a fairly close strainer made of brass gauze and of such a type that easy and rapid renewal is possible. The oil in most cases being pumped through pipe lines, pieces of pump packing are occasionally contained in the oil, and if a piece of this substance gets into the suction valves of the fuel oil set, it will be found that "fuel oil" has a very "spreading quality" in regard to clothes, etc., during the operation of hunting for the obstruction.

On the discharge side of oil set a very fine mesh strainer must be placed and by having two or more spare straining elements a foul strainer may be removed and a clean one substituted in a short time. By providing this strainer with a settling chamber and suitable draw off cock a large percentage of the moisture carried in suspension in the oil will be caught, and as the oil in passing through the heater has its temperature raised and thereby facilitating the precipitation of moisture, a settling chamber, as before mentioned, will be found to help considerably in the smooth operation of the burner. In fitting all oil lines be liberal with tees, as it is certainly quicker in the event of a stoppage simply to remove a plug and start a steam pressure in the pipe than to have to cut a nipple with the attendant mess and bother due to the oil "spreading around" and giving the floor that alternate "black and gray" tile effect so common to oil rooms.

See that the steam supply to the burner is of a size that will be ample, but favor as small a pipe as is consistent with good practice to carry the requisite amount of steam. The smaller the pipe (within the above limits) the better as the less surface presented to the atmosphere the less chance of the resultant condensation. There is an old saying that "oil and water will not mix." That is as may be, but from actual experience, the writer can say that water (under these given conditions) will not burn, having had several opportunities to demonstrate this fact when a load of oil containing a heavy per cent of water has been delivered.

Another factor that has close relation to smooth operation is a well lubricated oil feed pump, as the nearer the oil can be kept at a given pressure the steadier will be the atomization; but when a pump sticks and "lets down," say, 10 lb., the oil will be fed in a pulsing current and cause a gusty and noisy fire, besides making proper air admission more difficult, due to varying demand for oxygen according to size of flame.

Burner tips or nozzles should be carefully watched for wear, both by erosion and scaling, due to heat in furnace, any increase in the spraying orifice (that is, after the right orificial adjustment for that particular installation) will have a double effect in retarding economy: first, by taking more or allowing a greater volume of the spraying medium to pass through in the unit time; second, owing to a wider orifice the oil fuel will not be as finely torn apart or atomized, thereby immediately laying the foundation for a case of fuel loss.

The essential requisite for successfully burning a non-volatile fuel (fuel oil) is that the fuel be introduced into the furnace in such a form that the greatest possible surface be exposed to the furnace heat for the rapid assimilation of the oxygen atoms; hence it can readily be seen that the care bestowed upon tips will be well repaid.

THE UNDERWRITERS' BUREAU of the Middle and Southern States made the following suggestions as a safeguard against the spontaneous ignition of piles of soft coal:

"1. Storage should be kept, if possible, well away from the main buildings of the plant. Under no circumstances should it be piled up against a frame building. 2. If outside space will permit, the piles should be made low (not higher than 12 ft.), and of large area, rather than of small area, and piled high. 3. If wet coal is received, it should be dumped around the edges of the pile, or in some location where large quantities of other coal will not be packed on top of it. 4. If large amounts are stored, it is a good plan to insert wrought-iron pipes 2 or 3 in. in diameter into the piles, as they are built up. The lower ends of these pipes should be at different heights from the ground throughout the piles; probably one 3-in. pipe to every 400 sq. ft. of surface would be ample. This arrangement allows air to circulate freely through the coal pile, and is a great aid in preventing spontaneous ignition. The pipes should preferably be perforated, and it is a good plan to lower a thermometer occasionally through one of them to get a temperature reading from the center of the pile."—Refrigerating World.

Steam Regenerator at Mine Power Plant

EXHAUST STEAM FROM HOIST ENGINE IS USED IN LOW-PRESSURE TURBINE AFTER PASSING THROUGH STEAM REGENERATOR

NEAR Buckner, Ill., is a power station in which direct current at 250 volts is generated to operate the electric motors which are employed to cut and haul the coal in the mine, and operate the shaker screens and conveyors in the tipple and rescreener. Approximately 4500 tons is the daily mine output which is delivered to the weighing basket in the tipple in about 1100 dumps from the hoist. Upon discharging from the weighing basket, the coal slides over the shaker screen and all coal passing through the 3-in. holes is conveyed to the top of a rescreener, where it is again screened and then dropped into one of 5 bins, according to size. The tipple and rescreener motors vary in size from ½ to 60 hp. and form a total load of 180 hp. Coal is cut in the mine with 30 cutting machines, each of which is operated by a 25-hp. d.c. motor.

Mine haulage is accomplished with 17 electric locomotives, 15 of which are "gathering motors," and 2 are hauling motors; the gathering motors, which are 6-ton, and equipped with a 60-hp. d.c. motor, bring the loaded cars to sidings along a main passageway from which they are drawn to the hoisting shaft by the larger hauling locomotives, which are 13-ton and 10-ton and are driven by 150 and 125-hp. motors respectively.

Steam is generated at a pressure of 155 lb. in 4 330-hp. Geary water-tube boilers which are equipped with Model stokers of the dutch oven type, and a hand-fired Heine boiler rated at 485 hp. Furnace fuel is chiefly the refuse from the coal tipple or rescreener and is conveyed to the boiler room by a flight conveyor, driven by a 20-hp. motor and having a run of approximately 200 ft. It is dumped into steel hoppers from which double chutes discharge it to the stokers or firing floor.

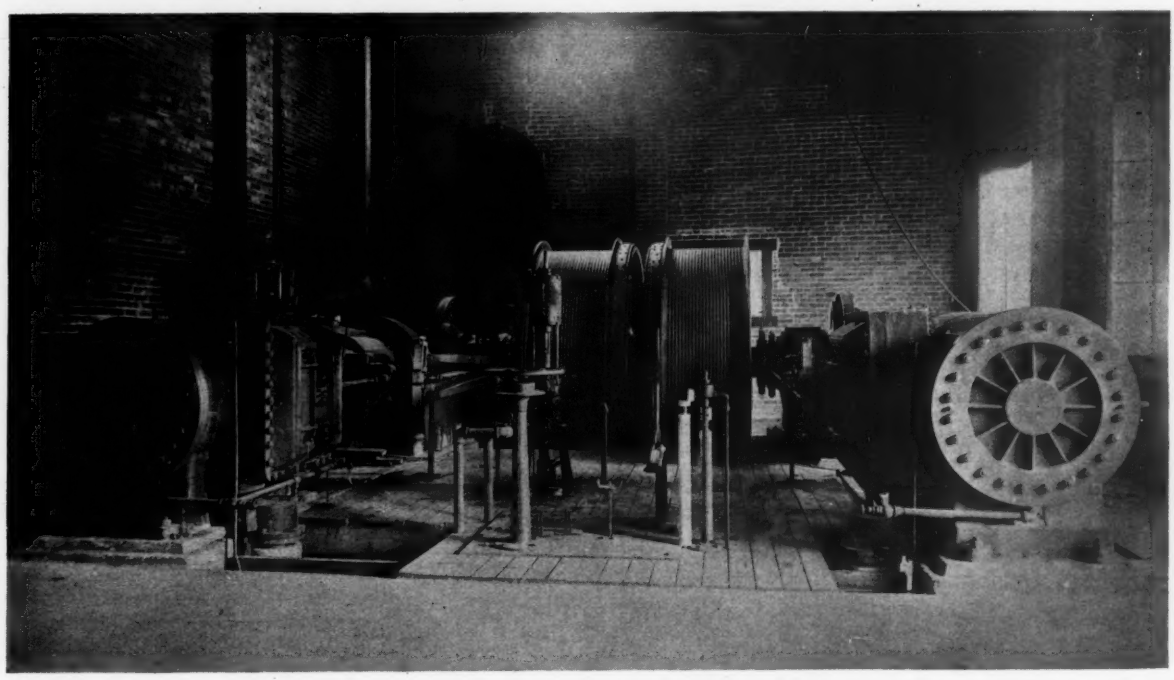


FIG. 1. HOIST ENGINE AT BUCKNER MINE

REGENERATING EXHAUST STEAM

IN MINE HOIST and rolling mill service, where the engine intermittently uses large quantities of steam under widely varying loads with little expansion, the installation of a steam accumulator or regenerator in connection with a low-pressure turbine is commendable from the standpoint of station economy. In this particular instance, the heat of the steam coming from the hoist engine during the exhaust period is stored and given off during the stop periods of the hoist to drive the turbine. This operation is based upon the principle that water, although at a temperature below 212 deg. F., will still evaporate, provided that a pressure proportionately less than atmospheric is maintained in the containing vessel.

Steam, exhausting into the American regenerator, passes through a mass of water which is rapidly circulated, thus causing the whole of the water to participate in the interchange of heat. This water absorbs the heat units in the steam during the periods of exhaust and when the engine stops, the water, owing to the fact that the pressure within the regenerator is reduced by a vacuum pump, commences to re-evaporate. The regenerator consists of a cylindrical shell, of ⅜-in. steel, 8½ ft. in diameter and 18 ft. long, which is about ¾

full of water. Steam enters a central chamber and is distributed through 10 6-in. branches, causing a continual forced circulation of the water.

An atmospheric relief valve, set to open at 20 lb. gage, is provided on the regenerator, which allows the exhaust steam to escape to the atmosphere or the condenser, if the turbine should not require all the steam exhausted from the hoist engine. Should the regenerator pressure drop below 16 lb. gage, due to a decrease in the exhaust steam supply, a reducing valve in a 4-in. high-pressure line from the boiler room is automatically

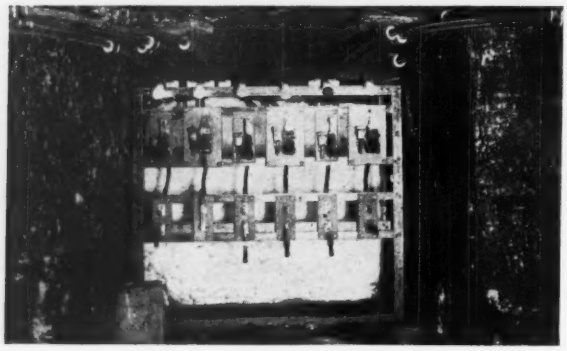


FIG. 2. MINE SWITCHBOARD

opened, admitting steam to the regenerator until the pressure rises to about 18 lb. gage.

Hoist Engine and Generating Units

Operating the 9-ft. drum which lifts the 2 cages in the main shaft is a Danville 28 by 48-in. slide valve engine with valves set to exhaust at approximately 5 lb. pressure, into an 18-in. spiral riveted line leading to the steam regenerator described above.

Driving a 500-kw. Westinghouse d.c. generator is a low-pressure Westinghouse-Parsons turbine, which re-

FIG. 3. GATHERING LOCOMOTIVE

ceives its steam through a 14-in. line from the regenerator. Interposed between the 2 machines is a 1 to 5 reducing gear, which reduces from the turbine speed of 3600 r.p.m. to 720 r.p.m. for the generator. Direct current is also produced by a 250-kw. Crocker-Wheeler generator direct connected to a Chuse, 20 by 24-in., 4-valve engine, and a 200-kw. Northern Electric Co. generator, driven by an 18 by 18-in. Ames engine. Three 1,000,000-cir.mil. copper cables leading from the main switchboard run down the hoist shaft and connect to the mine switchboard, shown in Fig. 2, from which the 3 lines supported close to the roof extend to 3 trolley circuits.

About 270 ft. from the power house is the auxiliary single-cage hoist shaft for men and materials, at which a separately housed 15 by 30-in. Crawford & McCrimmon engine is provided to operate a 5-ft. drum. Adjacent to this hoist shaft is a 16.5 by 1-ft. air shaft through which ventilating air is supplied to the mine. Draft is provided by an 18 by 8-ft. Clifford fan, operated at 120 r.p.m. by an 18 by 24-in. Chuse 4-valve engine which is housed in a separate building near the auxiliary shaft. Steam for these 2 engines is carried from the boiler house in a 7-in. well insulated line. A 4-in. spiral riveted line carries exhaust steam from the fan and hoist engines to the miners' wash house.

Food Economy

TO SECURE co-operation and action throughout the country in the important movement for conservation of foods, particularly those which can be advantageously shipped abroad for the use of our allies and expeditionary forces, the Chamber of Commerce of the United States urges compliance of everybody with Herbert Hoover's six requests as follows: One wheatless meal each day. To eat beef, mutton or pork not more than once a day, and no veal or lamb. To economize in the use of butter—none for cooking. To reduce the use of sugar in tea and coffee and in other ways. Eat more vegetables, fruit and fish. To urge and practice in home and restaurants economy in the use of food.

These are mostly individual and family matters, and the movement to save food against our own future needs, and the present and future needs of our allies, can only be a complete success as each individual and family earnestly undertakes to do all possible by example and urging to assist as much as possible.

In its effort to secure economy in the conduct of business, the Council of National Defense has asked that bakers discontinue the practice of accepting the return of bread from retailers, that drygoods and department stores curtail severely the practice of allowing goods to be returned, that delivery service be arranged to avoid duplication and reduce the number of deliveries and that in some lines of business the number of styles be reduced, particularly in the garment and shoe trade, on which representatives are now at work for the styles for 1918. It is proposed that the readjustment be gradual in order to inconvenience the public and merchants as little as possible.

The Board of Commercial Economy of the Council of National Defense invites suggestions and asks that associations of business men and individuals consider the directions in which economies may be secured.

Good oak tanned belting about 3/16 in. thick will sustain 675 lb. for each inch of width; at the lacing 210 lb.; safe working tension, 55 lb. Vertical belts must be kept tighter than horizontal running belts to prevent slipping and should be kept in good pliable condition with belt dressing.—Chas. A. Schieren Co.

Electrical Machinery and Appliances

For Generating, Transmitting and Using Current

The Regulation Curve in Compound Generators

WAYS AND MEANS EMPLOYED TO OBTAIN DESIRED VOLTAGE AT VARIOUS LOADS. BY L. C. MCCLURE

THE voltage at the terminals of a direct-current generator is equal to the generated voltage less the resistance drop in the machine. This drop is proportional to the load current and can be compensated for by the series field. Due to armature reaction, the generated voltage also varies with change in load, but this variation is not proportional to the change in load as the same increments of load produce more effect on the generated voltage at some loads than at others.

The general formula for voltage generated in a direct-current machine is:

$$E = \frac{R \times W \times F \times P}{10^8}$$

E = induced volts, R = revolutions per second, W = wires per circuit, F = flux per pole, P = number of poles.

In this formula the terms R, W and P are fixed for any machine, operating at constant speed. Therefore, the only means of changing the induced voltage is to change the flux per pole. The only flux which is effective in generating voltage is that which crosses the air-gap. If the densities of the flux crossing the air-gap are plotted across one pole pitch, as ordinates above the line OO', the resultant curve *A*, Fig. 1, usually called a no-load field form, shows the density of the flux at each point and the area under this field form is a measure of the induced voltage. When current flows through the armature winding, another flux is set up, which opposes the main field flux at one pole tip, *M*, and aids it at the other pole tip, *N*. This effect of the armature current upon the main field flux, distorts the field form to some shape such as is shown by curve *B*, and changes the generated voltage in the ratio that the areas under the field forms are changed.

The amount that the no-load field form is distorted by full-load armature current, varies widely for different designs and is determined by various design proportions. Obviously, the distortion will be more when the armature ampere-turns are high in proportion to the shunt field ampere-turns; and anything which tends to increase the shunt field strength, will decrease distortion. Saturation of the magnetic circuit, obtained either by using a small number of conductors in the armature, or by cutting away a portion of the field pole punchings, tends to make a relatively strong field.

As the armature current is increased, the main field is weakened at one side of the pole and strengthened at the other. These opposite effects are equal in amount and neutralize each other as long as the magnetic circuit is not saturated. But at some load, usually about ⅓ of full load, the additional flux sent through ½ the pole produces saturation of that part of the magnetic circuit; then a further increase in load decreases the flux at one pole tip but does not increase it by the same amount at the other. Thus the total flux per pole is decreased and the field form assumes a shape such as is shown by curve *B*. The result is that, with the same excitation, the generator voltage will decrease after passing ⅓ load. So a generator which is to give the same terminal voltage at no load and full load, must have a series field strong enough to compensate for this decreased flux due to the armature distortion, as well as for the voltage drop in the windings. However, this additional field is not required at the low loads; so before the magnetic circuit becomes saturated, the voltage rises rapidly until some point about ⅓ load is reached, then it drops gradually, reaching the specified voltage at full load. Such a sudden rise in voltage at low load and gradual fall at higher loads constitutes what is called the "hump" in the voltage regulation curve. This explanation neglects the variation of shunt field strength

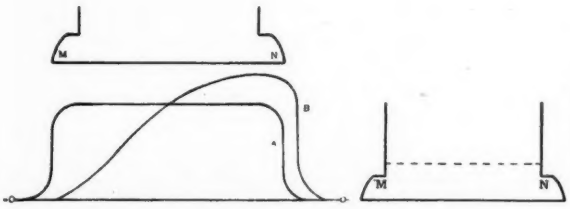
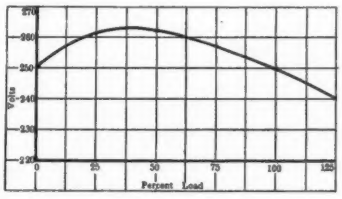


FIG. 1. FIELD FORM A—AT NO LOAD; B—WITH LOAD
FIG. 2. LAMINATIONS CUT OFF AT POLE TIP



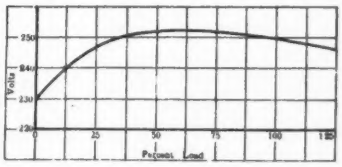


FIG. 3. REGULATION CURVE—250 V. AT NO LEAD AND FULL LOAD
FIG. 4. REGULATION CURVE—230 V. AT NO LOAD AND 250 V. AT FULL LOAD

due to the variation of terminal voltage on a self-exciting machine. Any shunt field variation has a cumulative effect on the magnitude of the hump which must be accounted for in the machine's design.

Special arrangements must be made in the design of the generator to prevent this hump in the regulation curve. The problem is to eliminate the effect of the armature current upon the field form. This may be done in either of two ways: The poles may be designed to prevent the decrease in total flux; or the armature reaction may be neutralized by compensating windings in the pole faces.

When the first method is used a portion of the laminations, about 50 to 60 per cent of the total, have their tips cut away somewhat as shown by the dotted line, Fig. 2. The effect of this is to saturate the iron below the cut off laminations at all loads. Then the effective ampere-turns, sending flux across the air gap at *M* and *N* change, the one decreasing and the other increasing, but the resultant flux changes only slightly; as the saturation of the iron makes a large change in ampere-turns necessary to produce any appreciable change in the flux. Therefore, changes in load do not materially change the shape of the field form. When the distorting effect of the load current upon the shape of the field form has been eliminated, the only remaining effect of the load current upon the terminal voltage is the resistance drop in the machine. Therefore, if the field windings are adjusted to give the desired voltages at no load and full load, then the series field will hold the voltage at intermediate loads, at a nearly constant value in case of flat regulation, or at values which rise in proportion to the load in case a rising regulation curve is desired.

This method of obtaining straight line voltage regulation has several disadvantages. The additional saturation in the magnetic circuit requires more copper in the shunt field, making the machine cost more, the no-load losses are increased, and the efficiency decreased due to the increased shunt excitation required; and the shape of the voltage regulation curve of the generator is dependent upon operating at exactly the right speed or voltage. Ten per cent increase of speed or 10 per cent reduction in voltage will destroy the benefit obtained by saturation of the pole faces.

Machines with compensating windings in the pole faces, inherently give a straight line regulation curve. The winding in the pole face slots is so proportioned, that it sets up a flux equal in strength and opposite in direction to the flux set up by the armature current. Since the same current flows through the armature and pole face winding, the armature distortion is equally corrected for at all loads. This accomplishes the same result obtained by using cutoff poles and a heavy shunt field. But applying compensating windings to a machine adds considerably to the complication of its winding and connections, and this method is rarely used with the single object in view of obtaining straight line regulation. It is one of the incidental advantages which is obtained when a generator is compensated to give it additional overload capacity, or to enable the generator to be built for a higher speed.

Most standard generators, in whose design no steps have been taken to obtain straight line regulation, are shipped with the regulation adjusted to give over-compounding in the proportion of 230 v. no load, to 250 v. full load. The rapid rise in voltage, due to the hump, brings it up to the full-load value at some point about ⅓ load, and from ⅓ to full load the voltage is practically constant. This gives the effect of flat compounding from ⅓ to full load, the range of load that is most used. This has proved suitable for most power plants where flat compounding is really desired. This voltage adjustment has the further advantage that the voltage is maintained nearer 250 v., when the machine is working on overloads.

When a standard generator is adjusted to give 250 v. flat compounding from no load to full load, several disadvantages are encountered. The hump in the regulation curve causes the voltage to rise rapidly between zero and ⅓ load and decrease slowly from that point to full load. This makes the voltage rise to 10 or 15 v. above the full-load voltage at ⅓ load with consequent burning out of lights or increase in speed of motors which are using power from this generator; and when the generator is operating on overload the voltage drops off rapidly with consequent detriment to the service.

In the small power plant usually the aim is to supply a constant voltage, over the normal range of load. This can best be supplied by using a standard generator, adjusted to give the desired voltage at ⅓ and full load, selected with a view to its simplicity and cost, rather than a special generator designed to give straight line regulation. This has the advantage that over the range of load which is most used, ¼ to full load, the voltage keeps within a small percentage of the full-load value, this departure being partly above and partly below the specified voltage. While this may be accomplished by using a special and more expensive machine designed to give straight line regulation, this is not necessary, since practically as good results may be obtained by using the standard machine adjusted as indicated.

A generator specially designed to give straight line regulation, gives possibly slightly better performance because it maintains the same voltage over the whole range of load; but it does this at a higher cost and with a sacrifice in efficiency.—The Electric Journal.

Transformer Costs on Underground Services

DATA FOR ESTIMATING INSTALLATION COSTS. BY JOHN D. MORGAN

ON all underground services, transformers are installed and it has become general practice to install them in the manholes, and this fact naturally adds a labor charge to the installation cost of transformers. The total cost of transformers for this class of service is generally subdivided as follows:

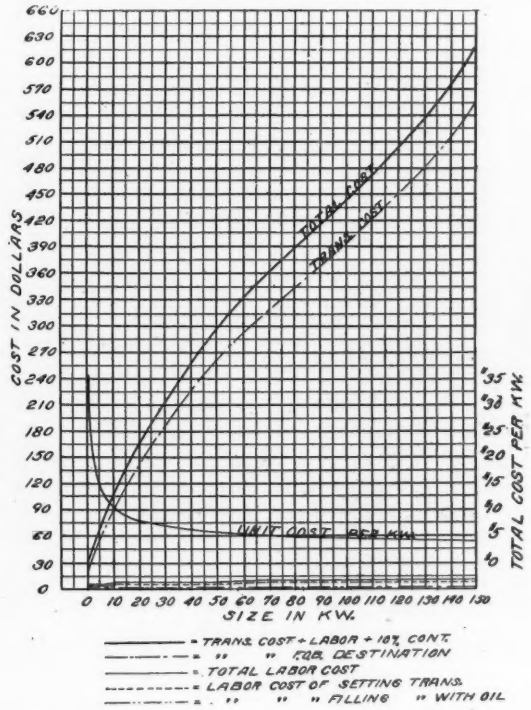
Material cost,
Labor cost,
Setting transformers in manhole,
Filling transformer with oil and stenciling.
General expenses.

As everyone knows, the material or transformer cost is subject to wide fluctuations in accordance with the raw material and manufacturing labor costs; hence, any discussion of this cost must be confined to actual dates or conditions and that any prices given in an article of this nature are true only for the date given. In the curve

given, the cost of transformer is for Jan. 1, 1916, and therefore is about 10 per cent above the normal price of the last 5 yr.

The labor cost, however, is subject only to rate paid and amount of work done, and is only a comparatively small percentage of the total cost, yet, to the distribution man, it is very important; therefore, in this discussion, it is the principal topic.

The setting of transformers is the first operation and is generally understood to consist of trucking the transformer to job and setting it, but not connecting or filling with oil. A table is given below which shows the gang needed, the number of transformers set per day and the unit labor setting cost per transformer:


COST IN DOLLARS
TOTAL COST
TRANS. ONLY
UNIT COST PER KW.
TOTAL COST PER KW.
SIZE IN KW.
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150
= TRANS. COST + LABOR + 10% CONT.
= TOTAL LABOR COST
= LABOR COST OF SETTING TRANS.
= LABOR COST OF FILLING WITH OIL

COST OF TRANSFORMERS ON UNDERGROUND LINES

Gang Title	No.	Rate	Cost
Foreman	1	$4.50	$ 4.50
Helpers	4	2.25	9.00
Driver	1	3.75	3.75
Auto.	1	....	12.00
Total			$29.25

	—Unit Per Day—		
	1—7.5kw.	10—50kw.	75—150kw.
Transformers set	8	6	4
	Unit Cost Per Transformer		
Labor Cost	$3.66	$4.88	$7.31
10% for bad weather	.37	.49	.73
Total labor cost	$4.03	$5.37	$8.04

Filling the transformer with oil is the next step and this operation is generally understood to consist of carting oil to the transformer and filling. The approximate amount of oil needed per kilowatt is about 5 qt.

The table given below shows the gang needed, the number of transformers filled per day and the unit cost per transformer:

TRANSFORMERS FILLED
6 transformers, all sizes

Gang Title	No.	Rate	Cost
Helper	1	$2.25	$ 2.25
Splicer	1	4.50	4.50
Wagon	1	4.00	4.00
Total			$10.75

UNIT COST

Labor cost	$1.79
10% for bad weather	.18
Total filling labor cost	$1.97

Stenciling a transformer generally costs about 3 cents per transformer.

As will be noticed, in all labor assumptions 10 per cent has been added to the labor cost for bad weather; this percentage has been generally accepted as a proper charge on all work done out in the open.

The general expense or contingency charge is perhaps the hardest of all charges to compute, due to the large number of elements entering into it, such as office expense, general supervision, etc.; but, at all events, it is a proper charge and most engineers have assumed it to be about 10 per cent.

Massachusetts Electricians' License

By Receiver

ALL having charge of or engaged in the installation of wiring or fixtures for electric light, heat and power must have a certificate or license.

Certificates are divided in classes: A, for master electricians, firms or individuals engaged in business and employing others to do the work; B, for those actually at work on the job. At present, all applicants for certificate must take an examination.

The applicant fills out a form giving his experience which he encloses in a numbered envelope, this being his number for the examination and placed on all answer sheets for identification.

Ten questions are given on the Electrical Code and 5 practical questions, the practical problems being supplemented by demonstration of the applicant's knowledge of putting up wires and fixtures. If he fails on the practical part, his written answers are not marked. If he succeeds, the written work is corrected and a grade of 70 passes him for license.

Some questions asked in an examination recently given are as follows:

1. Should drop cord be used in show windows?
2. What is the safe carrying capacity of No. 12 rubber-covered wire used for inside wiring?
3. How should wires to carry alternating currents be run in conduits?
4. Should bell circuits be run in the same conduit with lighting wires?

5. How would you ground a conduit?
6. Why would you use the method given for 5?
7. How should stranded wires be joined?
8. How would you splice wires in wood molding?
9. How would you connect No. 14 to No. 10 wire?
10. What kind of wire should be used for inside wiring in dry locations?
11. Show by sketch the direction of travel of currents in a 3-wire system for 110-220 volts direct current with loads on the two sides balanced.
12. Show by sketch how to connect up a lamp to be lighted from any one of three places.
13. How would you test a conduit for grounds?
14. How would you test a line for a ground? How for a short circuit?
15. How are cutouts installed?

The use of notes during the examination is not allowed.

The answers are corrected by the Board of Examiners of Electricians, and the applicant is sent his license, if he passes, or notified of his failure.

Charge for examination is $1, but if an applicant fails, he is entitled to another examination without payment. If he fails the second time, he cannot apply for further examination until 3 mo. have passed.

All licenses expire on July 31 of each year, and can be renewed at an expense of $15 for class A or $0.50 for Class B.

Low Cost of Handling Water

City of Clarksburg, W. Va., Reduces Cost of Operation by Installation of Gas-Engine Driven Centrifugal Pumps

In some localities natural gas of high heat value can be obtained at remarkably low cost. Taking advantage of this fact and of the superior efficiency of the gas engine as compared with the steam engine, the City of Clarksburg, W. Va., has been able to reduce the fuel cost of pumping to about $7 per water horsepower per year.

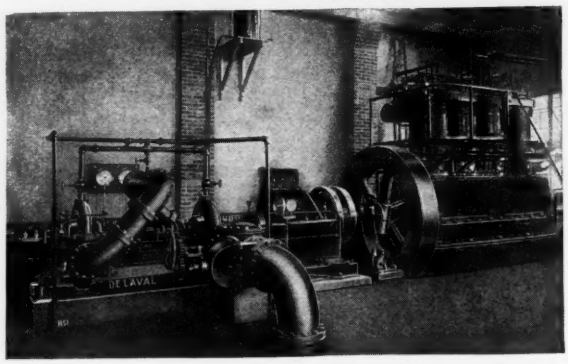
The pumping equipment recently put in service at Clarksburg consists of a 50-hp. gas engine driving through speed increasing gears a 4,000,000-gal. per day De Laval centrifugal pump, which delivers water against 35 ft. head to the filter bed, and a 350-hp. gas engine running at 200 r.p.m., driving through double-helical speed-increasing gears a De Laval two-stage centrifugal pump, delivering 4,000,000 gal. per day against 350 ft. head to the city reservoir. The latter unit is illustrated herewith.

The gas engine was guaranteed by the maker to deliver a brake horsepower on 10 cu. ft. per hour of gas of a heating value of 1000 B.t.u. per cubic foot. During a 10 days' continuous run the total consumption of the high-service and low-service pumps together was found to average 82,200 cu. ft. of gas per day. During this run the capacity was kept up to 4,100,000 gal. per day, the high-service pump delivering against about 330 ft. head, and the low-service pump against 30 ft. head, a total of about 258.5 water horsepower. The gas is received from wells nearby belonging to the city and is charged for at 6 cents per 1000 cu. ft., although the commercial power rate in that locality is about 8c. The fuel cost of a water horsepower would be $6.96 per year at 6c and $9.27 at 8c.

Formerly water was supplied by engine-driven centrifugal low-service pumps and duplex direct-acting high-service pumps, receiving steam from gas-fired boilers. With this equipment the gas consumption was about 350,000 cu. ft. per day, at a pumpage rate of approximately 3,000,000 gal. When additional capacity and new equipment became necessary, the Clarksburg Water and Sewage Board, and their engineer, G. W. Fuller, made a careful investigation of the following: steam-driven centrifugal pumps, steam-driven crank-and-flywheel pumping engines, gas-engine-driven direct-acting pumps and gas-engine-driven centrifugal pumps.

The preliminary estimates showed that the best gas consumption with steam-driven pumps would be about three times that of gas-engine-driven pumps and, in view of the rapid depletion of the natural gas supply in the neighborhood, it was deemed advisable to put in the more economical, although more expensive, equipment in order that the city's gas wells might last as long as possible.

Bids were finally requested on gas-engine-driven



HIGH PRESSURE GAS-ENGINE DRIVEN CENTRIFUGAL PUMP OF THE CITY OF CLARKSBURG

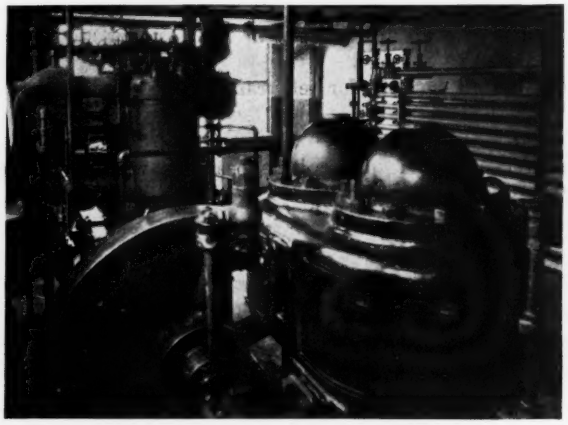
direct-acting pumps and gas-engine-driven centrifugal pumps. The units offered by the Dravo-Doyle Co., of Pittsburgh, representing the De Laval Steam Turbine Co., involving the use of double-helical speed increasing gears driving high-efficiency, high-speed centrifugal pumps were accepted because of the high overall economy and the greater simplicity and lower expense for maintenance of the centrifugal type of pump, together with saving in floor space and a material reduction in the first cost of the equipment.

The complete cost of the pumping equipment was approximately $17,500. The cost of the substructure, superstructure, crane, piping and appurtenances complete was $13,905, or a total of $31,405. The annual interest, depreciation and upkeep charges upon this amount at 8 per cent would be $2,512.40 per year, or $9.71 per water horsepower, giving a total cost of pumping, exclusive of attendance and supplies, of $16.67 per water horsepower year of 365 days of 24 hr. each. For 16 hr. operation the cost would be $14.35. These figures compare favorably with those previously cited for much larger steam-driven pumping units.

Economical Gas-Engine Drives

DURING the winter months, the cooling rooms of the Shedd Creamery Co., of Detroit, Mich., are maintained at temperatures sufficiently low by outside air. In summer, it is necessary to operate the 30-ton York ammonia compressor only 4 to 5 hr. during the day.

After making calculations, electrical current was not considered to be favorable nor was an installation of steam generating equipment justified by the small and intermittent power demands. Gas was selected and the installation of a 75-hp. Bruce-Macbeth gas engine, running at 275 r.p.m. has been operated at high economy.



GAS ENGINE OPERATING 30-TON AMMONIA COMPRESSOR

In Cleveland, Ohio, at the Osborn Mfg. Co., a 150-hp. gas engine of similar build is direct connected to a 100-kw. Sprague Electric Co., direct-current generator and is delivering a kw.-hr. at the switchboard for an average gas consumption of 17.2 cu. ft.

Charts for Power Transmission Problems

BELT HORSEPOWER; BEARING FRICTION. BY W. F. SCHAPHORST

BELT charts and formulas generally apply to leather belts only, and users of substitute belts have been at sea in applying such charts to their conditions. There is a demand, therefore, for a chart that will include all commonly used belts in a clear, simple way. The rapid advance of the substitute belting makes the demand for such a chart all the more urgent.

The chart in the Reference Tables was designed to meet present-day demands. It is simple, clear, and based on formulas that are most in use. Lay a straightedge across the chart twice and the problem is solved.

For example, what horsepower may be transmitted by a "light double" solid woven treated belt whose width is 5 in. and whose speed is 2000 ft. per min.?

Connect the 5 (column A) with the 2000 (column C), as shown by the dotted line and locate the intersection with column B. Then run a horizontal line through the intersection point and where the horizontal cuts column 2 we find the answer to be about 16.7 hp. It is easy to run a horizontal line across, because the divisions in columns A and C are identical. The figures in column C are simply 100 times greater than those in column A.

By following this same method any ordinary problem may be solved, no matter what the make of belt.

If it is desired to determine the belt width necessary to transmit a given power, the above process is reversed. That is, first decide on the kind of belt and the thickness. Locate the column through which the horizontal line must pass. Run the horizontal line, and locate the intersection with column B. Then run a line through that intersection and through the belt speed (column C) and the intersection with column A gives the belt width.

These tables will be found useful for determining the columns to be used with the various thicknesses of belt.

SOLID WOVEN COTTON TREATED BELT

"Single," column 1.
"Light double," column 2.
"Regular double," column 3.
"Triple," column 4.

LEATHER BELT

"Single," column 1.
"Extra heavy single" or "Light double," column 2.
"Double," column 3.
"Triple," column 4.

STITCHED BELT

4-ply	column 1	8-ply	column 3
6-ply	column 2	10-ply	column 4

RUBBER BELT

4-ply	column 1	8-ply	column 3
6-ply	column 2	10-ply	column 4

BALATA BELT

4-ply	column 1	8-ply	column 3
6-ply	column 2	10-ply	column 4

It will be noted that the tables for stitched, rubber and Balata belts are identical, but to avoid confusion it was deemed best to give each separately.

To show how the tables are used, let us suppose that you want to transmit 100 hp. with a 16-in. Balata belt of 8-ply. At what speed must the belt be operated?

The table says "use column 3."

Run a horizontal line through the 100, column 3, and locate the intersection with column B.

A line through that intersection point and the 16 (column A) shows that the speed should be 3200 ft. per min., column C.

The range of the chart is great enough to take care of any ordinary transmission problem, the horsepower valves varying all the way from 0.142 hp. to 900 hp.

A fine black thread is an excellent instrument to use on this chart in place of a straightedge, if such a thread happens to be available. Anything straight, of course, will do the work.

HOW MUCH POWER DOES A BEARING ABSORB?

LAY STRAIGHTEDGE across the chart in the Practical Reference Tables under the caption Power Absorbed by Bearing three times, as indicated by the dotted lines, and it will give the horsepower consumed by any bearing, coefficients of friction varying from 0.0006 to 0.6; shaft diameters from 0.1 to 10 in.; r.p.m. from

100 to 10,000; and the load on the bearing from 10 to 10,000 lb.

For example, using a coefficient of friction of 0.02 (column A), which is average practice; a shaft diameter of 2 in. (column C); a speed of 2000 r.p.m. (column E) and a 400-lb. load on the bearing (column G), column D gives the friction horsepower as a little over 0.25.

Connect the known values in column A with that in column C and locate the intersection with column B. In the same way connect columns E and G and locate the intersection with column F. Lastly, connect the intersections (columns B and F) and the intersection with column D gives the Friction Horsepower of the Bearing.

Column A gives an idea as to coefficients met with in everyday practice, beginning with the very best conditions and ending with starting friction.

Coefficients of friction under the many possible conditions are given in text books, in Alford's "Bearings," and in such handbooks as "Kent" and Lionel S. Mark's new "Mechanical Engineers' Handbook."

Only the general safe values of practice are designated on this chart.

The principal function of the chart is to quicken computations and make it usable for anybody who has to do with bearings.

The chart, of course, can be used "backward" as well as forward. For example, if the power absorption by a given bearing is known, and if values in columns C, E and G are known, the coefficient of friction is quickly determinable.

Then, knowing the coefficient of friction with a given oil and in a given bearing, the power required by a similar bearing of different diameter, speed and loading may be found with an accuracy sufficient for most practice.

The chart explains many things—teaches many lessons. For example, for belt transmission practice it tells us to run belts with as little tension as possible; to run shafts at low speeds if possible; to use small shafts, preferably; and to keep the bearings well oiled with the proper oil and in good condition.

War-Time Developments

MODERN WARFARE PRESENTS PROBLEMS AND OPPORTUNITIES TO ENGINEERS

AN unusual opportunity for those desiring to become marine engineers is offered in the call by the Shipping Board for engineers to serve on the forthcoming merchant marine fleet. Not less than 5000 additional engineer officers will be needed on American ships in the next 18 mo. Anticipating the demand, the board has established marine engineering schools in which to train men not now qualified to receive papers. The first term began July 20, and each term will last one month. The expense of tuition is borne by the shipping board and the work is being carried out at the Massachusetts Institute of Technology, Cambridge, Mass.; Stevens Institute, Hoboken, N. J.; Case School of Applied Science, Cleveland, O.; Armour Institute of Technology, Chicago, Ill.; Washington University, Seattle, and Tulane University, New Orleans. Marine engineers of all grades, oilers and water tenders and stationary engineers are eligible for the classes.

AUTOS, AIRPLANES, MOTOR BOATS

TO PROVIDE the government with all possible information regarding manufacturing facilities and the possibilities of expansion of government work, the automotive committee of the Council of National Defense has inaugurated an industrial inventory of factories making automobiles, airplanes and water craft. By this means, the government will secure exact information as to just what can be expected from each plant, and also the requirements of the industries in the way of additional labor and machinery, making it possible to plan accurately and intelligently for expansion.

The Aircraft Production Board has undertaken the design of standard engines to be built in four sizes of 4, 6, 8 and 12 cylinders, the corresponding horsepowers being 100, 200, 300 and 400. The facilities of the Bureau of Standards for the assembly of this engine have been placed at the disposal of the Aircraft Production Board, as well as the accumulated knowledge of the bureau and its staff of the various metallurgical processes necessary for the successful completion of the engine.

With an appropriation of $640,000,000 for aircraft construction, prompt action has been taken, and although considerable time will be required for making jigs, tools and gages necessary for manufacturing large numbers of fighting planes, some machines are now in service for training the men, three of the twenty-four big fields are completed and instruction on them has begun. The up-to-date pilot must know how to groom his machine and to attend to every detail of its inner workings. He must be expert to the point that his machine is only secondary and he can give all his attention to his military problem. It has been found that former officers of cavalry and artillery often make the best aviation officers as an able cavalryman is an expert at reconnaissance and artillerymen are trained in all the subtle tricks of gun-fire.

As for military trucks, it is thought that by standardization, by which manufacturers of parts can all be turned to making the same interchangeable design, the army can be assured of ample supplies for possible greater demands on the capacity of the industry in the future. In this program the Government has the co-operation of the industry as voiced at a meeting of 2000 representatives held recently at Columbus, Ohio.

COAL GAS TAKES PLACE OF GASOLINE

WITH GASOLINE at a price of 61 ct. per gallon, numerous substitutes have appeared on the market in England for furnishing vehicular motive power, and it is reported that coal gas has passed the experimental stage, a motor bus having made a journey of 130 mi. without taking on a fresh fuel supply. The only change made in the motor is the fitting of a butterfly valve in the air-intake

pipe for the regulation of the air supply which allows the engine to draw the gas in the correct quantity according to load and speed. It is claimed that an advantage due to the use of gas is that the engine is cleaner and the valves do not require grinding in so often. The principal disadvantage to its use on automobiles is the bulky container for the gas.

The War Department's Recognition of the Need for Engineers

P. P. Claxton, United States Commissioner of Education, under the authorization of the Secretary of War, has addressed a letter to the Presidents of the various technical schools and colleges of the United States, in part as follows:

"The successful prosecution of the war depends in large degree on the services of scientific and technical experts. It is of the utmost importance that the supply of men who have had advanced technical training should not be cut off more than is necessary. In view of this fact, the War Department believes that students in technical schools and colleges who are within the age limits of the selective draft should be treated in the same manner as the workers in the industries which are devoted to the manufacture of war materials. It is expected that institutional officers will exercise due caution and will not claim exemption for students whose success in technical careers is open to doubt.

"I am bringing this matter to your attention with the authorization of the Secretary of War. The importance of it is emphasized by the enclosed data indicating the small number of available engineers in the country at the present time."

Graduates in engineering 1895 to 1916 inclusive:

Chemical engineering	1,172
Civil engineering	11,621
Electrical engineering	6,357
Mechanical engineering	11,291
Mining engineering	3,195
Metallurgical engineering	150
Engineering (general)	1,897
Marine engineering	15
Textile engineering	48
Agricultural engineering	31
	35,777

Except for the years 1915 and 1916, these numbers include both bachelor's and graduate degrees.

Students in engineering in 1916:

General engineering	5,485
Chemical engineering	2,774
Civil engineering	7,251
Electrical engineering	7,098
Mechanical engineering	7,707
Mining engineering	1,790
Other types of engineering	1,001
	33,106

Storage Facilities Development Big War Need

Extraordinary conditions prevailing during the war bring producers and manufacturers to face three great demands: first, to develop storage facilities at points of production to avoid congestion in manufacture; second, to develop such facilities for finished goods near the point of consumption or shipment abroad in order to minimize the need for railroad cars; and third, in general to create conditions under which railroad cars will not be used for storage purposes.

Unless adequate preparations are made to store materials or goods on the arrival of railroad cars, these cars themselves must of necessity be used for storage purposes. Ocean transportation at best is irregular and today the conditions are uncertain, to say the least. Often in the past two years shipments for France and England have so accumulated at New York and other ports that many hundreds of cars for months have not only blocked terminal facilities but side tracks all the way to Buffalo and Pittsburgh.

Expert Baling an Essential Factor

Baling or compressing products for shipment is developing great possibilities for saving transportation space. Already socks and blankets are being baled and satisfactory progress is being made toward baling uniforms, shoes and even prunes. Bales are covered with a waterproof material which is later used for sand bags at the front. One advantage of baling is that use can be made of flat cars in shipping merchandise.

The Storage Committee has been developing the use of motor trucks for short hauls in order to release freight cars for the longer ones. Railroad cars have frequently been used in cities to transport goods only a few blocks, it is said. Now that our demand upon the railroads is so great we are told no time is to be lost in making use of the opportunities presented by the motor trucks for short haul.

College Men Take Up Storage Study

Special courses training men for work in handling stores are now being given at the Universities of Harvard, Pennsylvania, Michigan, Wisconsin, Dartmouth, Chicago, Northwestern, Georgia, Washington, Columbia and Illinois. Nearly one thousand men now attending or who have attended these courses have enlisted in the government service for the period of the war.

The utmost which the railroads are able to do is not equal to the needs of the government and of the great business being done today. In fact, it is said, facilities of transportation are very likely to be the limiting factor on general business unless there is close co-operation between business men and the railroads. Business men will see, therefore, how deep is their concern that no avoidable demand be made upon the railroads either for transportation or for the use of railroad cars for storage purposes.

Nothing Less Than a Car

Steps should be taken to eliminate less than car load shipment by combining such shipments for many manufacturers in a locality and by establishing centers for distributing by truck shipments received in car lots and for receiving goods in a similar manner for outbound movement in car lots. Effort should also be made to bring about the loading of railroad cars to full car capacity.

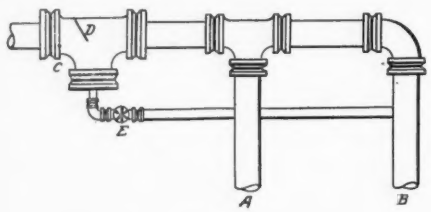
LETTERS DIRECT FROM THE PLANT

Cash Paid For Ideas Accepted. Sketches Desirable.
We Make The Drawings

Suction Connections Need Rearranging

UNDER THE ABOVE HEAD, A. J. Dixon discusses, in the July 1 issue, page 547, the trouble and resultant loss of economy due to one machine running colder than the other and the consequent necessity of throttling the suction valve on the colder machine, and he suggests that the proper remedy would be to arrange suction connections as he has shown, where the main suction is connected to the central point of a header between the two machines.

The remedy suggested by Mr. Dixon will improve matters and may remedy them entirely, and then again it may not. I have run three different plants connected just as he suggests, and we had the same trouble. The machines were of the same dimensions and run at the same speed in all cases. We never attempted to equalize the temperatures by throttling the suction valves, however, as it pretty soon showed up in the amount of ice made. We run one machine pretty cold and the other was left to run as hot as it wanted to and in this manner we got pretty good results.



CONNECTIONS SUGGESTED BY E. W. MILLER

Theoretically, if the gas came back dry, that is, that no liquid was carried back with the gas, both machines should run at the same temperature without trouble. A large number of machines, however, seem to operate better, both as to economy and wear and tear, if the suction gas carries a little liquid with it. There is also less trouble with the packing and the stuffing box when the machine is operated in this manner.

Throttling the suction valves is about the worst thing that can be done, unless one cares nothing for either efficiency or capacity. It will be granted that throttling the suction gas, if carried far enough, will equalize the temperature of the machines; but, as can be readily seen from Mr. Dixon's discussion, the efficiency suffers.

The accompanying illustration shows how we remedied this trouble in one plant. The suction was connected the same as shown in Fig. 1 of Mr. Dixon's article and the troubles encountered were the same; the machine at the end of the suction line always ran very hot, while the other one farther ahead on the line ran entirely too cold.

At first, I intended to remedy the trouble by changing the connections as suggested by Mr. Dixon, but I finally hit upon a simpler and much more satisfactory solution of the problem. Referring to the illustration, A and B represent the compressor connections, which were the same as shown in Fig. 1 of Mr. Dixon's problem. The suction line was 6-in.; at point C the line was cut and an 8-in. tee inserted, 6 by 8-in. reducing flanges being used on the pipes to connect them to the tee. A deflecting plate, D, was placed in the tee, as shown; the object of this was to deflect the gas and throw the liquid entrained in the gas to the bottom of the tee.

At the bottom of the tee a blind flange, tapped for a 1-in. pipe, was placed. From here a 1-in. line was run and connected to the suction of compressor B, as shown. A valve was placed in the line at E for regulation. When everything was ready and tested, the machines were started and I somewhat nervously awaited developments. It exceeded my most sanguine expectations from the start. The liquid, as I had expected, accumulated in the tee and it was a simple matter to adjust the valve at E so that the temperature of the compressor at B was the same as that of the one at A. The scheme has been in operation now for over two years, and it has eliminated all the trouble we used to have with the stuffing boxes on account of the one machine running altogether too cold and the other entirely too hot. As far as the capacity and efficiency are concerned, there does not seem to be much difference. E. W. MILLER.

Making Uptake Doors Tight

I HAVE WAITED patiently for some reader to come forward with a hint or with a suggestion in response to Receiver's appeal as appeared on page 324 of the April 1 issue, about how to make the uptake doors tight, and prevent the excess oxygen and loss of draft. I have had like trouble and have straightened the doors by using jack screws and blocking. After taking the warp out of the doors, I riveted angle iron strengthening or reinforcing pieces as near the edge of the door as possible, using plenty of rivets, also adding several extra dogs, or securing clamps. This aided a whole lot but did not cure the trouble.

While the doors were in place on the idle boilers and cold, they appeared to be nearly a perfect fit; but as soon as the boilers were heated up and in use, the old metal in the doors began to bulge or warp again. These boilers, like Receiver's, were pretty old, and we did not wish to expend much money on renewing the doors; so in order to eliminate this wasteful leak, we use a mixture of plastic asbestos and fireclay to keep these openings in the door seatings closed. This makes the joint absolutely air tight. A bucket of this stuff is always kept on hand. When needed, a little water

is mixed and it is readily applied. In fact, we use this mixture to stop up all leaks into the setting through all parts of the sheet steel uptakes or boiler casings.

It is my opinion that when the sheet steel of the doors has been subjected to many years of heating and cooling, the life of the metal is gone, and that the only way to cure this trouble permanently would be to renew the doors. If there is a reader who has found a way to straighten old uptake doors and make them stay tight, I know that if he will tell of it to the rest of us through Practical Engineer, it will help out and be appreciated by a large number of engineers who are in the same fix as Receiver and I. C. H. W.

Is the Indicator at Fault?

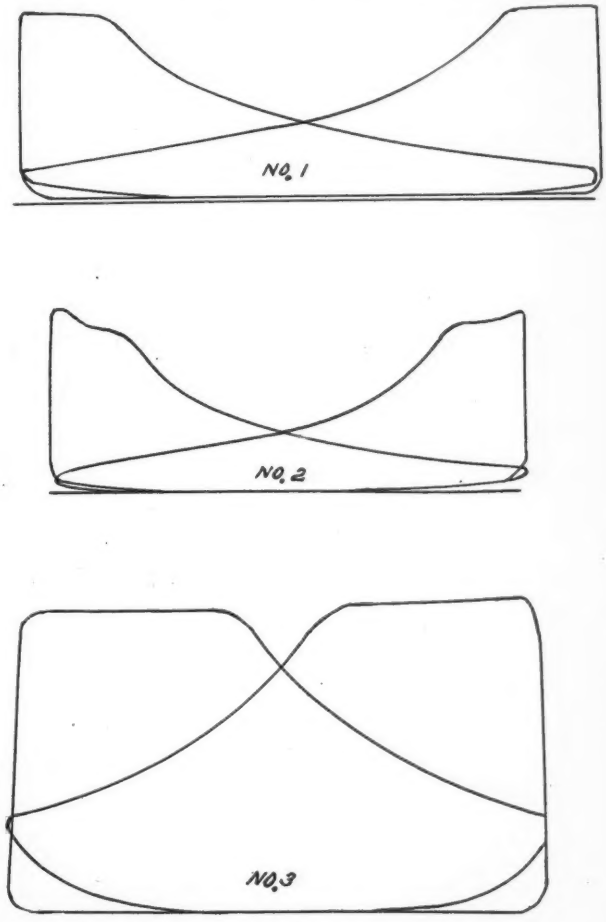
WITH 15 YR. EXPERIENCE in engineering and use of the indicator, this is the first freak card I have taken, and could not make it change its lines and look like any respectable card should. I have never seen a card published in any of the many mechanical papers I have taken, nor such a card shown and commented on in any indicator treatise I have ever seen; therefore, I feel this ought to stir up some lively interest among the readers of Practical Engineer.

Before answering Mr. Moulson and Mr. Hawkins, I wish to explain why I condemned the indicator.

The first cards I took from these engines were with a borrowed machine, a card of which I am enclosing herewith marked No. 1, and I think you will all agree with me that while it could be bettered, it is a good looking and an average card. Some time after taking No. 1, I had the cylinders rebored and fitted with new heads and naturally expected to get a better card than before, and you can imagine my surprise in getting the ones as published in the May 15 issue. I did not lay it to the indicator, however, until I had tried all of the adjustments I could think of, and looked for the trouble elsewhere, other than valve setting; but as I could not get a card that even remotely resembled card No. 1, I was forced to the conclusion that one or the other of the instruments was wrong and I had various reasons for thinking the new one was wrong some place. I knew, however, even before my article was published, that the instrument was O.K. and had time to change that part of my letter, but thought I would let it slide and see what it would bring forth in way of comment. Regarding the card from the lighting engine, when I got to it I was somewhat discouraged with the indicator, and after taking one or two cards as published, I quit, not trying to make any adjustments whatever to better them. As the engine ran well, I jumped at the conclusion that the engine was probably as near right as the indicator was. Since, however, I retarded the eccentric, taking off some of the lead, and equalized the travel of the valve a trifle, getting as good a card as an engine of that type can show.

I wish Mr. Moulson would tell me how he can tell those cards were taken from a twin engine, as I did not know there were any distinctive features between the cards of a single or twin engine. The only remarkable thing about the cards that I know of, is the hump, and the fact that I happened to send two that showed a little longer cutoff on head end, which is due to the fact that the load varied about the time I switched ends, can pick out other cards with no change to cam rods showing the same condition only on the crank end. These engines are in a saw mill and the load varies from a light friction load to around 1600 hp.

Mr. Moulson must be mistaken when he says: "Advancing the eccentric will shorten the maximum cutoff; that is, will make the gear fail to release at light loads." That is entirely wrong, for the simple reason that advancing the eccentric does not change the length of cam rods which control the cutoff; therefore, if the engine cuts off at all, it would have to be on a light load; for with the eccentric advanced to such an extent, it could not pull a heavy one. Now, Mr. Moulson, I will ask



CARDS TAKEN BEFORE AND AFTER REPAIRS WERE MADE AND WHICH INDICATE THAT HUMP DISAPPEARS AS LOAD INCREASES

that you try to tell me what you think is the cause of the hump in the steam line. Getting the release and compression is not what is worrying me; they can be improved upon to a certain extent; however, you can only go so far with a single eccentric machine.

To Mr. Hawkins I would say that testing this indicator with others was done. I sent and got the instrument I had first and it showed exactly the same card as No. 1, while with the new instrument I got card No. 2 with the same valve setting, reducing motion, scale of spring, etc. Card No. 3 is taken from the same engine, same valve setting, etc. Now, what I want to know is,

why does the engine show a freak card on light load and a fairly good card on heavy loads? Will say I have been advised by the engineering department of the indicator company that the steam main was too small, which causes the hump, and was advised the same by the builders of the engine and by the coast expert of the engine company, that the main was large enough and that the trouble was in the valve setting. The pipe cannot be too small when it gives a card like No. 3, as that shows absolutely no wiredrawing of steam caused by too small a pipe.

I am fully satisfied the cause is not in the valve setting. Both stationary and marine engineers, successful operating men, have been candid in admitting they did not know the cause. I thought when I submitted the first cards that some reader may have met with the same experience and could tell immediately what the cause was. Card No. 3 shows lead a trifle late, so it cannot be caused by excessive lead. I have advanced the eccentric until I had the line looking nice, but it caused the engine to pound. As I prefer a good running engine to a nice looking card, I put the eccentric back again. Card No. 3 was taken with another standard instrument and it shows exactly the same on light loads as the other instrument. As I said, it cannot be caused by excessive lead; and it is a self-evident fact that it cannot be caused by the compression, as it has no more than the law allows. As the machine is double ported, it cannot be caused by restricted port opening, so what could cause it?

E. C. D.

Cause of Knock in Cylinder

A FEW YEARS ago, I took charge of a small ice plant having Frick vertical compressors, direct driven by their Eclipse Corliss engines.

Upon starting up for the first time, I noticed a sharp knock in the cylinder (steam), apparently in the crank end. I was told that the knock had shown up the previous season and that my predecessor had been unable to eliminate it.

I examined everything about the cylinder valve gear, crosshead, etc., but could locate nothing wrong. While I had her down, I took a look at the valve setting and found about 5/16 in. lead on the crank and ¼ in. on the head end. The cylinder diameter was 13 in.

I then thought I had located the trouble. I gave the steam valves about 1/32 in. lead, and started her up. No knock. I put the indicator on and it showed good valve setting. I shut it down and went home (about 1 a.m.). Next morning I started her up, and still no knock. Everyone around was commenting upon how nicely she was running.

While I was strolling around, patting myself on the back, about noon she started knocking again as badly as ever.

Thinking the eccentric or something had slipped, I put on the indicator, but it showed the same as the previous day.

I dismantled the blooming thing and endeavored to locate the trouble, had very poor success.

When running again, I accidentally discovered that when the lubricator was feeding rapidly she knocked louder, and by experimenting, found that with just enough oil to prevent seizing of the valves, she wouldn't knock at all, but the instant a lot of oil hit the valves it all started again.

I never did figure out a satisfactory theory as to the reason why plenty of cylinder oil made the knock come back. There was practically no end play in the valves and the machine was nearly new.

In the plant of which I am in charge at present, we have two machines, the smaller of which is of the same type, only slightly larger than the one mentioned above.

During the winter, I did quite a bit of work on it and recommended reboring the steam cylinder and valve chambers, as they were badly worn. It was decided, however, that this was unnecessary.

After reassembling and starting up, she ran nicely for about 10 days, when a sharp knock appeared in the cylinder, apparently in the head end steam valve, although at times it appeared to be on the other end.

I looked the valves over and decided that end play was the cause, for there was room for 5/16 in. of it.

Putting collars behind the valve stem heads did no good. I took off the cylinder head and apparently everything was as good as ever.

I spent some time trying to locate it, and had almost given up when I remembered that the cavity in the cylinder head, which is intended to be filled by the piston rod nut on the back stroke had been filled with babbit metal on account of the piston rod having broken off right at the piston and the rod had been riveted over. I again took the head off and discovered that the chunk of babbit (which had appeared tight at the previous inspection) was loose, and when the piston reached the head end it hit that piece of babbit, thus producing my knock. What fooled me was that there was no perceptible jar on the cylinder head when the piston hit the babbit.

R. B.

Length of Cutoff on a Corliss Engine

IN THE first column, on page 592 of the July 15 issue, R. A. Cultra says: "The average length of cutoff on a Corliss engine with a single eccentric is about 2/5 stroke, and with a double eccentric ½ stroke. This is the general limit of the governor action," etc.

Now, the length of cutoff on a Corliss engine is determined by the load, and there is no way of determining even a respectable guess concerning the average. It is different on various engines, and constantly changing on the same engine.

The limit of cutoff is another problem, and should not be mixed up with the average in practice. A man may sit at his desk and calculate that the limit of cutoff in such cases is less than ½ stroke for a single eccentric, because it must be advanced to give lead and to compensate for lap; but when he gets down to business and applies his indicator, he finds that he can secure a cutoff at ½ stroke. He has not taken into consideration the following: When at the limit of automatic cutoff, the steam valve of a Corliss engine is wide open. It is then tripped; but it requires a fraction of a second to close, and during this short space of time the piston is traveling at a very high speed, consequently it arrives at ½ stroke as soon as the valve is closed. This is general practice, and not an isolated case.

The object sought in adding another eccentric is not to increase the power (as it is not increased by this operation), but to extend the limit of automatic cutoff to ¾ stroke, and it secures this desirable action for a heavily loaded engine.

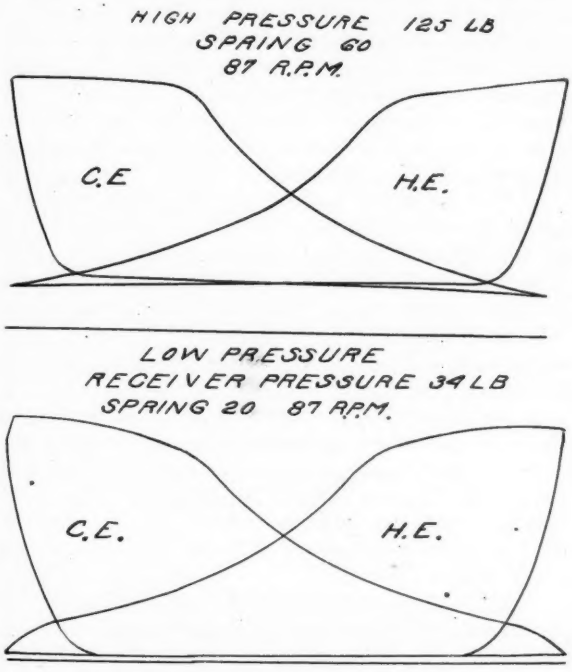
W. H. WAKEMAN.

Questions Answered and For Answer

Expert Help When In Trouble. If You Want Quick Answer Enclose a Stamp

What Causes the Pound?

I AM SENDING two cards taken from our engine. We have trouble with our engine pounding and have trouble keeping the lost motion out of crankpin boxes. I would appreciate suggestions as to what we can do to make



CARDS FROM COMPOUND ENGINE WHICH POUNDS

engine run smoothly. If you see anything wrong with the cards, please let us know what it is, and what to do to remedy the fault. G. R. C.

Belt and Pump Problems

I HAVE a 3-in. motor pulley and an 8-in. driven pulley with 17½-in. centers, over which travel a 1½-in. single leather belt. The motor operates at 1165 r.p.m.; the arc of contact is not quite 180 deg.

Without any slip, the belt would travel 914 ft. per min. and it appears to me that this is too high a speed over a 3-in. pulley. Could you give me a table or formula for the maximum and most economical speeds for single and double leather and canvas belts?

2. In a pump discharging water at 100 to 180 deg. F. against a pressure of from 2 to 3 lb., what is the maximum velocity at which the water should pass through the valves and from under the valve discs? One of the passages of the pump has a section of but 1⅜ sq. in., which seems rather small.

This is a single-acting double pump running at 65 r.p.m. when handling water and air. Give answers to the above questions when the pump is handling water only, when handling 50 per cent air and 50 per cent water and when handling air only.

Are not the springs of a pump handling air and water lighter than when handling water only, and still lighter when handling air only? G. A. W.

ANSWERS

IT MAY BE said that the maximum speed of belts is about 4000 ft. per minute. About 3500 ft. per minute for main belts is a speed that agrees with good practice, and lathe belts operate at from 1500 to 2000 ft. per minute. With these values considered, your belt speed of 940 ft. per minute is not excessively high but is lower than the average drives.

The speed of a belt is determined by the belt width and the horsepower to be transmitted. Following are some handy formulas transpired from values given in Kent's Mechanical Engineer's Handbook.

For single leather belts, many authorities give as safe practice, a working tension of 45 lb. per inch of width, and the velocity is given as:

$$(a) \qquad v = \frac{733 \text{ hp.}}{w}$$

in which v = speed of belt in feet per minute, 733 = value determined by working strain, hp. = horsepower transmitted, w = width of belt.

Another common rule states that a belt 1 in. wide traveling 1000 ft. per min. = 1 hp. and, corresponding to a working strain of 33 lb. per inch of width:

$$(b) \qquad v = \frac{1000 \text{ hp.}}{w}$$

For double belts of average thickness, some writers say that the transmitting efficiency is to that of single belts as 10 to 7, which, from the formula (a) would give:

$$(c) \qquad v = \frac{513 \text{ hp.}}{w}$$

Other authorities, however, make the transmitting power of a double belt twice that of a single belt, on the assumption that its thickness is twice as great.

Canvas belting has about the same strength as leather belting, and being subjected to similar working tensions, the speeds would correspond approximately to those of leather belting of the same thickness.

2. The maximum velocity of water passing through pump valves, at a temperature between 100 and 180 deg. F., is about 250 ft. per minute. For a mixture of water and air and for air only the velocity would be less; but

owing to the lack of specific data on this particular subject, we are unable to state any definite values.

Valve springs for a pump handling a mixture of air and water are a trifle lighter than those handling water only, and still a trifle lighter when only air is handled.

W. P.

Determining Velocity of Water in Pipes

How do you find the velocity of feed water to a boiler when boiler pressure, pump pressure and size of pipe and height are known?

2. How can the size of piping be determined when piping steam to an engine and what size exhaust pipe should be used? C. I. G.

Answers

Your question in regard to the velocity of feed water to the boiler is put in an unusual way; while there are formulas derived for finding this velocity from the information you give, they are subject to considerable error and must be used with considerable allowance, as the condition of the pipe, number of fittings, types of fittings, etc., all enter into the problem and change the results.

The following formula is probably as accurate as any, and we give it with the above warning:

$$v = 47.5\sqrt{\frac{0.43\,d\,(P-p)}{l}}, \text{ in which}$$

v = velocity in feet per second of the water.
P = discharge pressure of the pump in lb. per sq. in.
p = boiler pressure in lb. per sq. in.
d = diameter of pipe in feet.
l = length of pipe in feet.

2. The size of steam pipe to a simple engine may be determined from the following formula:

$$d = \sqrt{\frac{D^2 \times S}{8000}}, \text{ in which}$$

d = diameter of the steam pipe.
D = diameter of cylinder.
S = piston speed in feet per minute.
8000 = assumed velocity of the steam in the pipe in feet per minute.

The exhaust pipe diameter is ordinarily taken as equal to 0.4 the diameter of the cylinder.

R. E. T.

Kilowatts and Kilovolt-Amperes

I would be pleased to have you explain to me the rating of an alternating-current generator, the name plate of which reads 7000 kv.a. What will this machine deliver in kilowatts and how is it figured? S. E. G.

A. It is only alternating-current apparatus which is rated in kilovolt-amperes instead of kilowatts.

Power delivered by a direct-current generator is always equal to the product of the number of volts times the number of amperes flow of current at any particular instant. That is, if such a machine is delivering 200 amp. at a voltage of 500, the output is 100,000 w. or 100 kw., and if this machine is delivering 100 amp. at the same voltage, the output is but 50,000 w. or 50 kw. From this we see, considering the voltage maintained constant, that in the case of direct-current generators, the power delivered is always in direct proportion to the current flow.

In the study of alternating currents, we find, however, that this is not always the case. Due to the nature of the apparatus supplied and the connecting lines, that is, due to the condenser or inductive effect of such apparatus and lines, the current waves do not always rise and fall in step with the electromotive force waves. With a condenser effect the current "leads" the electromotive force or the current wave travels ahead of the electromotive force wave and with an inductive effect the current "lags" behind the electromotive force, or the current wave travels somewhat behind the electromotive force wave. As a result of this phenomena, unless the current wave is in exact step with the electromotive force wave, the actual or useful power delivered by any alternating-current generator is not equal to the product of the number of amperes times the number of volts. This product is known as the apparent watts. The actual power delivered by such a machine is obtained only by means of a watt meter or watt-hour meter.

It is, therefore, seen that when an alternating current generator feeds a circuit the nature of which is to cause the current to lead or lag, the product of the number of volts times the number of amperes is in no way an indication of the power being delivered. The current flow may be such as to indicate an overload and even cause the generator to "groan" and the engine to "lie down" and still, due to this heavy "apparent" load the unit may actually be delivering only ½ of its rated kilowatt capacity.

If, therefore, manufacturers of electrical machinery rated alternating-current generators in kilowatts, the customer who bought such a machine may be justified to complain if it was found the machine could not carry a given load based upon the product of volt-amperes, when in reality the fault would lie in the nature of the circuit fed.

It is, therefore, customary to rate alternating-current generators in kilovolt amperes, as for example in your case, 7000 kv.a. If the voltage rating of the machine is 1000, this then means that the machine is fully loaded when carrying a current of 7000 amp., regardless of whether the actual or the useful power being delivered is 7000 kw. or 5000 kw. O. H. H.

Boiler and Engine Questions and Answers

What portion of the shell of an upright boiler is the thickest? Why?

2. Name some of the advantages and disadvantages of high-pressure steam.

3. What is the difference between cross-compound and triple-expansion engines?

4. How would you give a valve travel greater than the throw of the eccentric? G. A.

Answers

Usually the thickest part of an upright boiler is the heads. These are made thicker than the drum, in order to give more bearing surface between the tubes and the sheets when they are rolled, so as to give a tight joint. Of course, there is somewhat greater pressure on the lower courses than there is on the upper courses, due to the weight of the water; but this difference is so small as

compared to the total pressure carried, that no consideration would be given to it in constructing the boiler.

2. High-pressure steam gives a chance for better engine economy than low-pressure steam, and has a higher temperature, which for many industrial purposes is necessary. The disadvantage is, that it takes more coal to make a pound of high-pressure steam than to make a pound of low-pressure; the piping, machinery and joints must be stronger, and there will be a greater amount of condensation in the piping with high-pressure steam than with low-pressure.

3. The compound engine, whether cross-compound or tandem, has the steam exhaust from a high-pressure cylinder into a low-pressure, and from the low-pressure to the exhaust pipe, usually connected with a condenser. In case of a triple expansion engine, steam exhausts from the high-pressure cylinder to an intermediate-pressure; from the intermediate to a low-pressure, and from the low-pressure cylinder to the condenser.

4. To give a valve more travel than the throw of the eccentric, a rocker arm is introduced which has the length between the axis and the point where the eccentric rod is connected, less than the distance from the axis to the point where the valve rod is connected. A. L. R.

Leading and Lagging Currents

IN ALTERNATING-CURRENT work, reference is made to "leading" and "lagging" currents. What is meant by these terms? A. A. L.

A. The nature of alternating current is such, that if we represent its performance graphically, we find that, as shown below, the electromotive force and the current alternately rise and fall through positive and negative values, tending to approach, in doing so, a sine wave.

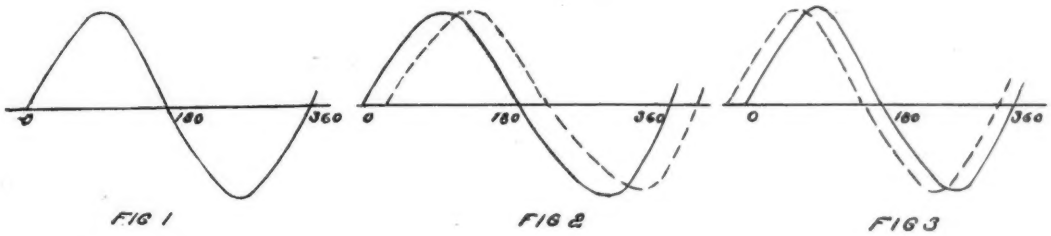


FIG. 1. COINCIDENT CURRENT AND ELECTROMOTIVE FORCE WAVES. FIG. 2. GRAPHICAL REPRESENTATION OF LAGGING CURRENT. FIG. 3. GRAPHICAL REPRESENTATION OF LEADING CURRENT

In Fig. 1 you will note that, starting at zero degree, the value of the electromotive force is zero. This, however, gradually rises, reaching the maximum at 90 deg., when it again falls to zero at 180 deg. It then rises in a negative direction, in the same manner, until at 360 deg. it is ready to repeat the cycle.

The wave shown in Fig. 1 may represent a coincident electromotive force and current wave, which is typical of any circuit containing neither inductance nor capacity. If, however, a circuit fed by an alternating-current machine connects up with apparatus having inductance, we find that the electromotive force and current waves are no longer in step—the current lagging a certain amount behind the electromotive force, depending upon the value of the inductance. This is shown in Fig. 2, where the full line represents the electromotive force wave, and the dotted line the current wave. You will there note that it is some little time after the electromotive force wave has started to rise, that the current wave is leaving the base line. It is this which is referred to as "lagging current."

If, however, instead of inductance, the circuit connects with apparatus having considerable capacity, such as a synchronous motor or rotary converter, the current, instead of lagging behind the electromotive force, will lead, as indicated in Fig. 3. O. H. H.

Operating Generators in Series

I HAVE two 110-v., 450-amp., direct-current generators operating in series, and wish to know what number of amperes these machines can deliver at full load. Is it 450 or 900 amp.?

There is a separate ammeter for each machine and these indicate 350 amp. each when the generators are operating almost fully loaded. Does this mean they are delivering 700 amp.? S. W. C.

A. If your two direct-current generators are each rated at 450 amp., 110 v., and are connected in series, the voltage delivered by these machines will be equal to 110 plus 110, or 220; or, in other words, the sum of the voltages of the individual machines. The current capable of being delivered by these machines is equal, however, only to the current capable of being delivered by either one of the machines, or, in your case, is equal to 450 amp. at full load.

Even though each one of these machines is provided with its individual ammeter, if these machines are connected in series, and the ammeters, in turn, connected in series with the machine, as would of necessity be the case, the reading of these ammeters indicates the load on the machines. That is, if each ammeter indicates a flow of 350 amp., the current delivered by both of these machines is equal to 350 amp., and not equal to 700 amp. O. H. H.

BY ROYAL DECREE the use of electricity and gas for signs and outdoor advertising has been prohibited in Sweden; and for private houses and commercial buildings the use is restricted to 60 per cent of the amount used during the like period last year, the rates being the same, 90.6 cents per 1000 cu. ft. for gas, and 9.4 cents per kw.-hr. for electricity. Where essential, an additional 30 per cent of the quantity used last year may be used at a higher rate, $3.78 per 1000 cu. ft. for gas, and 18.8 cents per kw.-hr. for electricity. If more than 90 per cent of the amount used during the past year is consumed, the gas and current will be cut off entirely.

PRACTICAL ENGINEER

Trade-mark, Reg. U. S. Pat. Off.

PUBLISHED ON THE FIRST AND FIFTEENTH OF EACH MONTH

BY THE TECHNICAL PUBLISHING CO.

537 South Dearborn Street,
CHICAGO, ILL.

New York Office, 150 Nassau St.

Notify us at once of any change of address, giving the old and the new address, so that your paper may always reach you promptly.

Copyright, 1917, by Technical Publishing Co.

Entered as second class matter May 1, 1908, at the Post Office at Chicago, Illinois, under the act of March 3, 1879.

Circulation of this issue, 22,000.

CONTENTS

Heating and Ventilation at Harrison Tech. Illustrated.....647

Heine Boiler Construction. Illustrated.....652

Oil Fuel Installations. By H. J. Geake.....655

Steam Regenerator at Mine Power Plant. Illustrated.....657

The Regulation Curve in Compound Generators. By L. C. McClure. Illustrated.....659

Transformer Coils on Underground Services. By John D. Morgan. Illustrated.....660

Massachusetts Electricians' License. By Receiver.....661

Low Cost of Handling Water. Illustrated.....662

Economical Gas-Engine Drives. Illustrated.....663

Charts for Power Transmission Problems. By W. F. Schaphorst 663

War-Time Developments 664

Letters Direct From the Plant: Suction Connections Need Rearranging. Making Uptake Doors Tight. Is the Indicator at Fault? Cause of Knock in Cylinder. Length of Cutoff on a Corliss Engine. Illustrated.....666

Questions Answered and for Answer: What Causes the Pound? Belt and Pump Problems. Determining Velocity of Water in Pipes. Kilowatts and Kilovolt-Amperes. Boiler and Engine Questions and Answers. Leading and Lagging Currents. Operating Generators in Series. Illustrated 669

Editorial: A New Name. Editorial Comments.....672

Food Conservation 673

Rocker Dump for Riley Stokers. Illustrated.....674

First Exclusive Insuluminum Plant.....675

The Process of "Spellerizing" as Applied to Pipe.....675

Diaphragm Type Pressure Regulator. Illustrated.....676

Conserving Fuel in Power Plants.....676

News Notes.....676

Practical Reference Tables: Chart for Calculating Horsepower of Various Kinds of Belts. Power Absorbed by Bearing. Volume of Mixture Per Pound of Air Handled by Dry Vacuum Condenser Pump. Barometric Readings at Different Altitudes. Pressures at Which Work is Equal in Two-Stage Air Compressors. Increase of Indicated Horsepower of Air Compression with Partial Intercooling 677

Books and Catalogs.....679

A New Name

For several years it has been evident that the name Practical Engineer has not defined the field to which this journal is devoted, nor has it clearly indicated the editorial treatment of the information in that field. The name has been vague and has been mistaken as applying to civil engineering, to mechanical engineering, shop practice and to other branches of engineering work.

Readers know that the service of Practical Engineer has been given solely to the power plant and that while the editorial policy has been to have all articles contain information in form to be of immediate use, hence of practical value, the principles and science of power plant installation and operation have been fully treated. There has been no thought of narrowing the field to rule-of-thumb methods or the detail of manual operations.

Realizing these defects in the present name, the time when so many former customs and conditions are changing, seemed opportune to adopt a name more clearly defining the particular field of work of the journal and more fully expressing its broad policy; and beginning with the issue of September 1, 1917, this journal will be known as Power Plant Engineering.

It will be issued, as heretofore, twice a month, 24 times a year; the subscription price will for the present be as before, $1 a year and the same editorial features and policy of immediate usefulness and service will be continued. Only the name will be changed in order to describe its field of work and to lend, perhaps, added dignity to the broad, progressive, helpful work that it is doing for the power plant industry and the men engaged in that industry.

Editorial Comments

HEATING AND VENTILATION AT HARRISON TECH. is more important to the health and development of the student than the books which he studies, and this statement casts no reflections upon the curriculum nor the teaching force, for this school ranks among the highest. But in a city like Chicago where the air is none too good anyway and growing young people are brought together in large numbers from all sections representing poor as well as good living conditions, the health of all is of highest importace. The important work of furnishing proper ventilation and maintaining a comfortable temperature falls upon the engineer and the means provided him are described in this issue.

HEINE BOILER CONSTRUCTION in every detail is highly approved by engineers as representing what is safe and dependable. As many of the states are passing laws prohibiting the use of boilers having construction features which are not safe, it behooves engineers to become familiar with details that represent best practice. The description given on another page will also be of considerable aid when repair to baffles or renewal of tubes are necessary.

OIL FUEL INSTALLATION are, in these times of high priced coal, being given more thoughtful study by power plant engineers than heretofore. Unquestionably fuel oil can, in many sections of the country, be used to advantage at all times; in some other places it will pay to have furnaces so equipped that they can burn

either coal or oil, depending upon the relative prices of the fuels. Mr. Geake gives some valuable suggestions on the use of fuel oil and the apparatus employed.

STEAM REGENERATOR AT MINE POWER PLANT, probably above all other locations, does its most efficient work. Hoisting engines with their intermittent operation are inherently low in efficiency, but with a regenerator to absorb heat from the engine exhaust during periods of operation and deliver it as steam to a low pressure turbine during periods when the engine is stopped, the overall efficiency is raised considerably above other arrangements. Other interesting features of the plant at Buckner are described in this article.

THE REGULATION CURVE IN COMPOUND GENERATORS has for years been the subject for study and investigation by electrical engineers but sufficient data is now available to enable designers to predict with reasonable accuracy the characteristics of their machines. Mr. McClure gives information along this line which will be appreciated by all operators and those having to do repair work as well as by designers.

TRANSFORMER COSTS ON UNDERGROUND SERVICES, as given by Mr. Morgan will aid in making estimates of extension work or in appraising property which is frequently the work of the engineer. This data should be preserved.

LOW COST OF HANDLING WATER with a gas-engine driven centrifugal pump has been demonstrated at Clarksburg, W. Va., where a change in equipment was made from a steam plant using gas as fuel. The figures given will interest all who have water to handle.

CHARTS FOR POWER TRANSMISSION PROBLEMS given in this issue reduce to a minimum the calculations necessary for determining the horsepower of belts and the power absorbed in bearings by friction. This method of presenting formulas for engineering calculations is in its infancy, but is rapidly becoming common practice and all should become accustomed to using charts as they undoubtedly save much time.

Food Conservation

NOW that we have those gardens, it is important for our satisfaction and for our food supply that we get and preserve the harvest. In many localities potatoes and other vegetables are being attacked by the aphis and, to save them it is necessary to spray promptly with Bordeaux mixture, as explained in the issue of July 1, p. 563. Delay may mean the loss of your crop, and even if the trouble has started, prompt and heavy spraying will help to prevent disaster.

When the crop is ready, the surplus above immediate consumption must be cared for so as to be available for next winter's use. Two methods are available, canning and drying. The former method has been explained in most household journals and daily papers, and in bulletins which can be had from the Department of Agriculture. For drying, it is found that the use of the electric fan is the quickest and surest way.

Fruits or vegetables, fresh and in good condition, should be washed and the hulls, stems and skins removed as for table use. Small fruits can be halved or left whole; apples and root vegetables should be sliced about ⅛ to ¼ in. thick. The drying is on trays, and can be done in the sun.

Blanch the product by steaming in an ordinary household steamer for 3 to 10 min., varying with the texture of the product and the amount. Spread on wooden trays with wire mesh bottom, for a 16-in. fan using trays 28 in. long by 24 in. wide and with sides 4 in. high, or a regular wire letter basket may be used. These may be stacked 3 or 4 high for a drying, the fan being so placed that the air blows up, along and through the trays, *not* down on them,—so as to carry away the moisture. For pease, corn and the like, use cheese cloth on the bottom of the basket or tray.

Materials should be turned and stirred several times to secure a uniform product, and the drying continued until no water can be pressed from a freshly cut end of the pieces. The dried product should be leathery, not dry enough to snap, having about 15 to 20 per cent of its original moisture retained. The product should lose 4/5 of its original weight in the drying, if succulent and fresh at the start.

Soft fruits should be spread only one layer deep, but vegetables may be spread to a depth of 1 in. or less. The process should be completed in 2 to 24 hr., depending on the moisture in the original material and the humidity of the air. In damp weather, the drying should be finished in a slow oven at a temperature below 200 deg. F. until the dried product meets the requirements outlined above.

Many people consider the dried product superior to canned. To prepare for the table, soak in enough water to cover, letting vegetables stand 2 to 3 hr. and fruits over night. Then cook until tender in the water in which the product was soaked.

The dried product may be stored in covered wooden boxes or pails, tin cans, wide mouthed glass jars or heavy paper containers, and need not be sealed.

The U. S. Department of Agriculture offers the following suggestion on canning tomatoes: Select firm, well-formed tomatoes. Scald 1½ min., or until skins loosen. Dip quickly into and out of cold water. Peel and remove stems and cores. Pack directly into cans or hot jars. Press down with a tablespoon (add no water). Add a level teaspoonful of salt per quart. Put the rubber rings and caps of jars into position, but do not tighten fully. Seal tin cans completely. Place the packed containers on a false bottom in a vessel of water sufficiently deep to cover them by one inch and allow to remain at a boiling temperature for 22 min. when using hot water bath canners.

More complete details can be found in Bulletin No. 841, which can be had free by writing to the Division of Publications, Dept. of Agriculture, Washington, D. C.

THE GOVERNMENT'S $11,000,000 armor plant, the selection of a site for which occasioned a national contest among cities large and small, is not to be built until after the war. This decision has been announced by Secretary of the Navy Daniels. The need for the entire output of steel plants already in operation is said to be so great that diversion of a part of it to a project of this magnitude would greatly hamper war preparations.

Power Apparatus in Shop and Market

New Ideas In Making, Buying and Selling

Rocker Dump for Riley Stokers

ONE of the features which in the past caused much trouble and expense in the operation of underfeed stokers, has been the formation of clinker at the lower end of the fire, which finally grew to large masses and welded itself to the bridge wall. Similar formation of clinker on the side wall was also experienced, but did not cause such serious effects in interrupting operation at high capacity; it had more effect on maintenance of brickwork, by tearing off a portion of the brick surface each time a clinker was detached by barring.

The moving retort sides of the Riley stoker practically put an end to the formation of side wall clinker, by continually shearing off and breaking up any clinker formation while still soft. The same valuable function has now been successfully applied to the bridge wall by means of the new rocker dump.

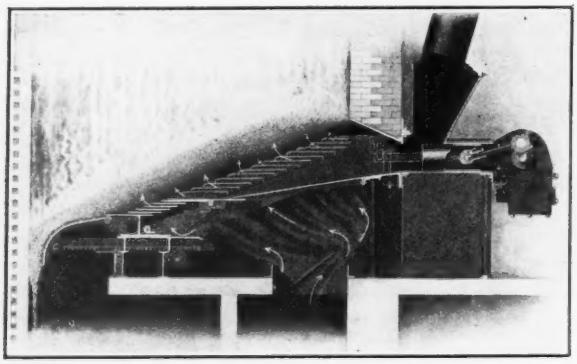


FIG. 1. CROSS-SECTION THROUGH STOKER SHOWING THE ROCKER DUMP APPLIED TO A REGULAR RILEY STOKER SETTING

Referring to the cut, the dump plate is attached to a trunnion fastened to the ends of the corresponding side bar. The outer end of the rocker plate is carried by a roller, attached to the racks which formerly supported the older apron-dump. The motion at the hinge is, of course, horizontal; that at the outer is tangential to the point of contact with the roller, and at all positions of the racks, is very nearly vertical. The resultant motion of the dump plate is much as if it were oscillated around an axis situated below the plate. The amount of opening is, of course, adjustable by means of the racks the same as with the apron-dump.

The design of overfeed section just above the dump plates has been improved with three objects in view:

(a) To reduce the possibility of serious burning at this point, by eliminating all large exposed vertical surfaces with small air supply. This is assured by ribbed flat grate bars with a larger number of small air openings.

(b) Greater ease of installation and removal of parts, so as to make maintenance labor as small as possible. This is accomplished by an arrangement which permits the removal of these parts without disturbing other portions of the furnace.

(c) The ability to supply adequate quantities of air to complete the combustion of coke at this point in the furnace. This is secured by the large percentage of air opening, all of which is under the control of the overfeed damper.

The advantages are:

(a) Continual disturbance of ash and clinker on the dump plates, obtaining the same shearing lines as between the retorts, with the resultant breaking up of clinker during formation and giving complete combustion of coke.

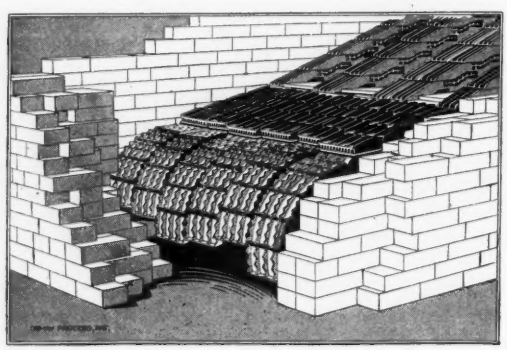


FIG. 2. PERSPECTIVE VIEW OF ROCKER DUMP

(b) Continuous vertical movement at the bridge wall, which practically prevents the adherence of clinker to the bridge wall, crushes what clinker is formed in the fire and ejects it. The maintenance on the bridge wall is consequently much reduced, and high capacity operation at all times guaranteed. This feature is especially valuable with high percentage of low fusibility ash.

(c) Reduction of dumping period to once in 24 hr. or longer, and the practical elimination of smoke during such dumping as is needed. The continuous discharge of ash and clinker keeps the fire in the best condition at all times, instead of the slow reduction of efficiency which begins after a dump and gets worse up to the next dump in the intermittent dumping method. The reduction of labor for the fireman is considerable.

(d) Convenience in handling ashes, since all the refuse comes out in comparatively small pieces, easy to convey and in fine condition for use as fill or for cinder concrete.

(e) Elimination of deep pockets for collecting ash, which can be (and frequently are) filled with unburned coke after a dump, by careless firemen, resulting in burned stoker parts, perhaps even in the disabling of the stoker.

(f) So designed as to fit directly on the standard stoker, without changes other than the removal of the old style apron parts and overfeed grates. This renders the improvement immediately available for present installations, as a maintenance proposition. One stoker at a time can be changed over, and all old parts removed, used as spares for the remaining stoker, till all are equipped.

This new style dump is operated with the greatest ease for dumping when necessary, and is the product of the Sanford Riley Stoker Co.

First Exclusive Insuluminum Plant

THE first plant devoted exclusively to the production of insuluminum soot blower units has been established at Detroit by the Diamond Power Specialty Co., manufacturers of Diamond Mechanical Soot Blowers.

This announcement is of special interest to the industrial world because the establishment of this plant marks the formal entry of a heat-treating process that will undoubtedly be adopted by many for the treatment of metal that is subject to unusual heat conditions. The process originated and was perfected in the laboratory of the General Electric Co.

The marked superiority of this new metal over iron and steel for unsual heat conditions has already commended itself to many of the leading manufacturers in the United States and Canada.

The originator of the new method, having in mind the heat-resisting qualities of the product, called the treatment "Calorizing." The essential point of difference between the effects of this process and any hitherto used commercially, such as galvanizing or sherardizing, is that the insulating material is not imposed as a coating, or skin (which may be chipped off), upon the surface of the metal to be treated, but on the contrary enters into intimate association with it, so that the whole outer region of the body affected, changes its composition. A homogeneous alloy is formed, which cannot be destroyed except as the mass of which it is a part is destroyed. The richness of the alloy is proportional to the depth of impregnation, which varies with the length of time of the treatment.

Insuluminum will resist for an indefinite time the continued action of temperatures of the order of 1000 deg. C. or 1800 F.

This is an exact statement of the heat-resisting quality of the new metal. Its importance is apparent from the fact that steel begins to burn, it is believed, at about 370 deg. C., and nickel 650 deg. C. Both of these metals will bear considerably higher temperatures, of course, but the oxidization of iron and steel becomes pronounced at 500 deg. C. and increases rapidly from this point on.

Tests covering a period of several years have been conducted by the Diamond Power Specialty Co. in order positively to determine the continued durability of insuluminum or calorized metal soot blower units. Insuluminum soot blower units are now safely placed in those parts of a boiler where units are necessary and where ordinary extra heavy steel units could not withstand the heat conditions.

Great credit is due W. R. Whitney, in charge of the General Electric Co.'s Research Laboratory, and to W. E. Ruder, who personally directed the installation, for the successful and early completion of the first exclusive Insuluminum plant. At present, it is being worked at its maximum capacity turning out Diamond Soot Blower units. It is expected that additional furnaces will be completed at an early date which will be used for calorizing a variety of other metal products which are subjected to unusual heat conditions.

The Process of "Spellerizing" as Applied to Pipe

COMMERCIALLY pure iron is produced in several forms; puddled iron, knobbled charcoal iron, so-called ingot iron and soft welding steel have much the same chemical composition as commercial products, but may differ considerably in physical properties and durability according to the treatment given in process of manufacture.

In so far as pipe is concerned, with which this article is particularly concerned, thorough investigation and research have shown that the greatest danger from corrosion occurs to the smaller sizes of pipe owing to the thinner walls. The larger sizes with thick walls are made from heavy plates of such uniform quality that corrosion does not seriously affect them.

To overcome the tendency to corrosion in the smaller sizes, a process has been evolved, known as "Spellerizing." This is technically defined as follows:

"Spellerizing is a process of treating metal which consists in subjecting the heated bloom to the action of rolls having regularly shaped projections on their working surfaces, then subjecting the bloom while still hot to the action of smooth-faced rolls and repeating the operation, whereby the surface of the metal is worked so as to produce a uniformly dense texture better adapted to resist corrosion, especially in the form of pitting."

Inasmuch as this process is entirely mechanical and does not in any way depend upon skilled labor, beyond keeping up the machinery involved, uniform treatment is assured.

The Spellerizing proeess is applicable to the smaller sizes of pipe—say, 4 in. and under—although it is possible in special cases to Spellerize pipe a few inches larger.

Pipe has been made by this process for 10 yr. in increasing amounts. It is significant to note that official records of the American Iron and Steel Institute show that during this period steel tubes and pipe have increased from 74.3 per cent of the total production in 1906 to 87.9 per cent in 1916.

A few special references to experiences in the use of this process and its influence on steel pipe may be of practical interest.

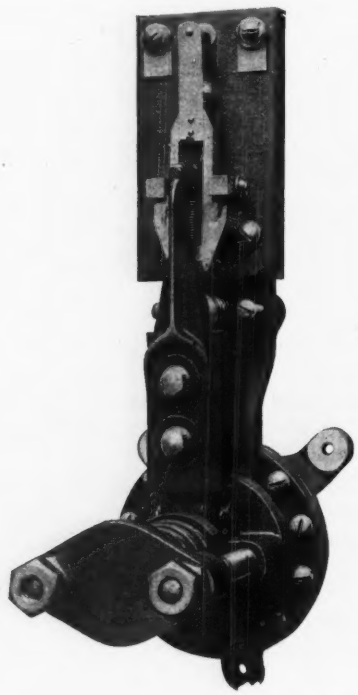
Morgan B. Smith, in the October, 1913, issue of Ice, states with reference to the merits of the Spellerizing process: "Steel pipe, which has been treated in such a manner as to eliminate or at least distribute evenly the mill scale, may be joined with wrought iron or cast iron safely as a rule. * * * The same stock without the treatment for mill scale will show a decided tendency to corrode when joined with wrought iron or cast iron. The so-called Spellerized steel fulfills this condition with respect to the scale."

The Gas Record (issue of Sept. 23, 1914, page 222) says: "Pipe steel made in 1906 by this roll-knobbling process tested against pipe steel made in 1897 resulted not only in a somewhat greater loss of weight by corrosion of the latter, but a decidedly deeper pitting of the 1897 steel in 6 mo. than occurred in the 1906 steel in 13 mo."

The evidence might be continued ad infinitum; but it is believed sufficient has been mentioned to show that the tendency of the Spellerizing process is to render the surface of pipe uniform and reduce the tendency to corrosion—especially in the form of pitting.

Diaphragm Type Pressure Regulator

IN THE illustration is shown a pressure regulator of the diaphragm type, for use with automatic starters on motors operating pump compressors and similar machines. These regulators require but 2 wires to connect them to the starters and are designed for use



WESTINGHOUSE PRESSURE REGULATOR

in connection with compressors or pumps emptying into closed pressure systems containing air, gas, water, or any fluid not injurious to the rubber diaphragm. They may also be used with pressure systems operated by oil or steam if a loop is introduced into the pipe leading to the regulator, to prevent the oil or steam from coming into direct contact with the diaphragm.

The regulator consists of 4 essential parts, the pressure chamber, the operating arm, the switch lever, and the adjusting springs. Inside of this pressure cylinder, which is of cast iron, is a heavy flexible rubber diaphragm. A piston attached to the diaphragm projects through the chamber and engages the operating arm, which actuates the switch lever. The operating springs oppose the movements of the piston and operating arm which actuates the switch lever, and may be adjusted to suit the requirements of the circuit on which the regulator is to operate. This regulator is placed on the market by the Westinghouse Electric & Mfg. Co., of Pittsburgh, Pa.

Conserving Fuel in Power Plants

IN LINE with the President's proclamation relative to the patriotic duty of all power plant operators to conserve fuel, the Combustion Engineering Corporation, 11 Broadway, New York City, manufacturers of Type "E" and Coxe stokers, have assigned one of their efficiency engineers until further notice to the work of traveling throughout the country to interview chief engineers and owners of such plants, with a view to reducing the fuel costs by increasing efficiency in every way possible, not only insofar as the stoker is concerned, but in helpful suggestions for minor improvements and changes which a great many plants can perfect with but small expense and trouble when such matters are brought to their attention.

It has been estimated that $600,000,000 is the annual fuel loss through inefficiency in power plants in the United States, and it is the purpose of the Combustion Engineering Corporation to give its full measure of cooperation to accomplishing results in cutting down this enormous waste.

In addition to this, for plants that are inaccessible or are not now using any of the company's products, a branch of the engineering department is engaged in supplying preliminary and synoptical reports stating economies that might be effected on receipt of the information as to operating conditions in these plants, and for that reason a special blank has been prepared which will be sent to any firm on request. This blank is in the form of a questionnaire on the conditions prevailing at the plant, and gives the engineering department sufficient data from which to determine whether or not material economy in fuel and increased efficiency would result by improving operating conditions.

News Notes

THE INGERSOLL-RAND CO. announces that at a meeting of the board of directors of the company, on July 25, 1917, J. H. Jowett, formerly general sales manager, was elected vice-president of the company, and that L. D. Albin, formerly assistant general sales manager, was appointed general sales manager.

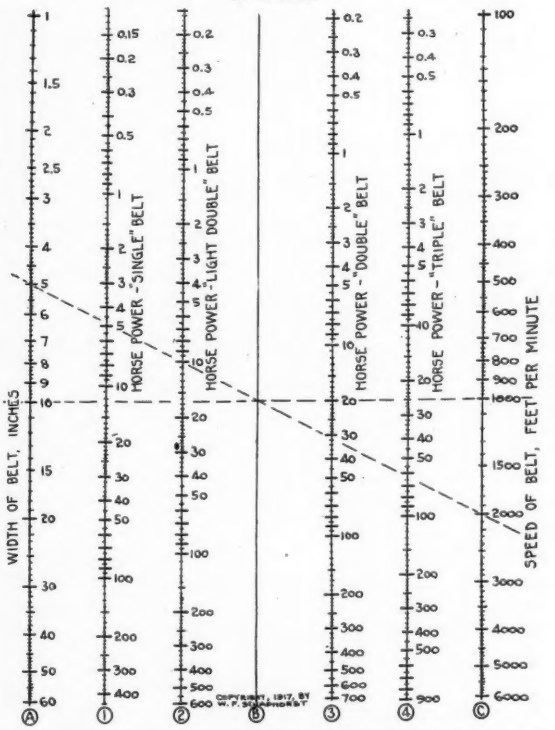
Mr. Jowett and Mr. Albin will continue to make the company's New York office, 11 Broadway, their headquarters.

These tables contain data especially worked out or carefully selected that are vital to your work. You may need them at any time and should

These tables contain data especially worked out or carefully selected that are vital to your work. You may need them at any time and should preserve them. A handy, serviceable, loose-leaf cover in which these tables fit exactly, will be sent you for 30 cents in currency or stamps.

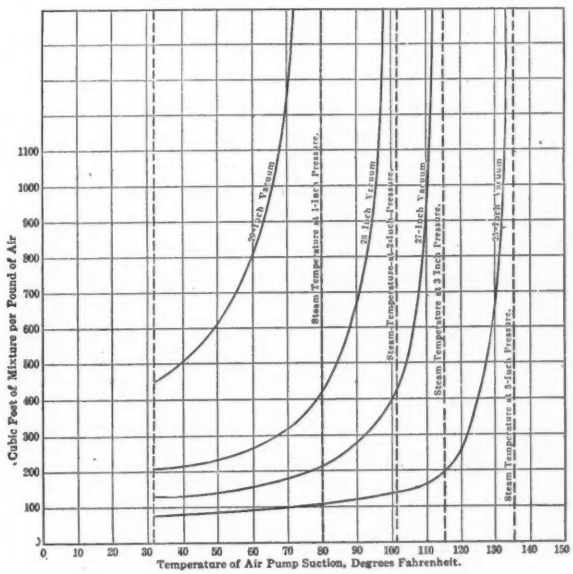
PRACTICAL ENGINEER

CHART FOR CIRCULATING HORSEPOWER OF VARIOUS KINDS OF BELTS



PRACTICAL ENGINEER

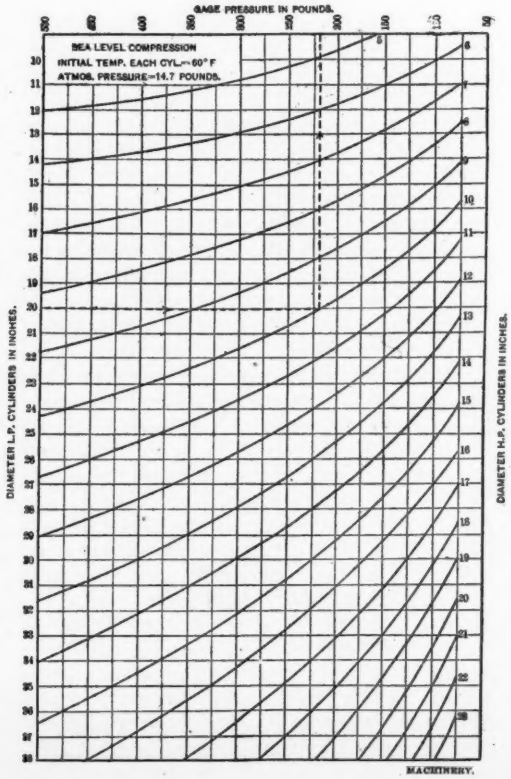
VOLUME OF MIXTURE PER POUND OF AIR HANDLED BY DRY VACUUM CONDENSER PUMP


Cubic Feet of Mixture per Pound of Air
Temperature of Air Pump Suction, Degrees Fahrenheit.
26-Inch Vacuum
Steam Temperature at 1-Inch Pressure.
28-Inch Vacuum
Steam Temperature at 2-Inch Pressure.
27-Inch Vacuum
Steam Temperature at 3-Inch Pressure.
29-Inch Vacuum
Steam Temperature at 5-Inch Pressure.

—Wheeler Condenser & Engineering Co.

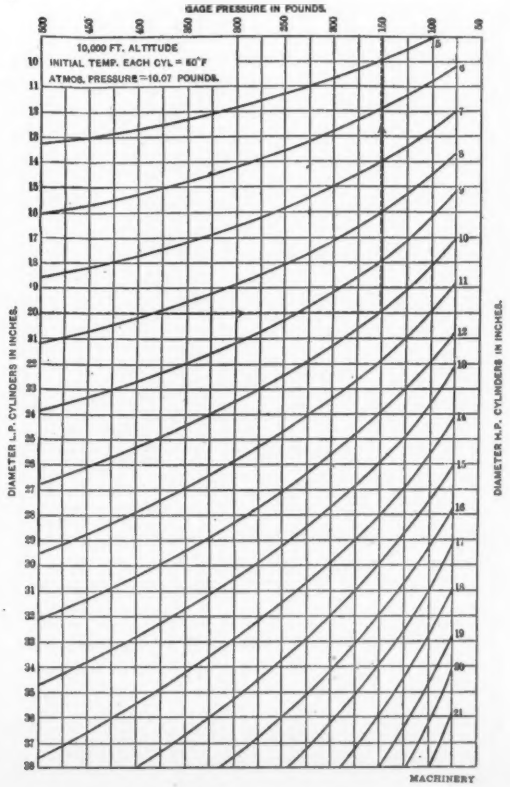
PRACTICAL ENGINEER

PRESSURES AT WHICH WORK IS EQUAL IN TWO-STAGE AIR COMPRESSORS. I


GAGE PRESSURE IN POUNDS.
SEA LEVEL COMPRESSION
INITIAL TEMP. EACH CYL. = 60° F
ATMOS. PRESSURE = 14.7 POUNDS.
DIAMETER L.P. CYLINDERS IN INCHES.
DIAMETER H.P. CYLINDERS IN INCHES.
MACHINERY.

PRACTICAL ENGINEER

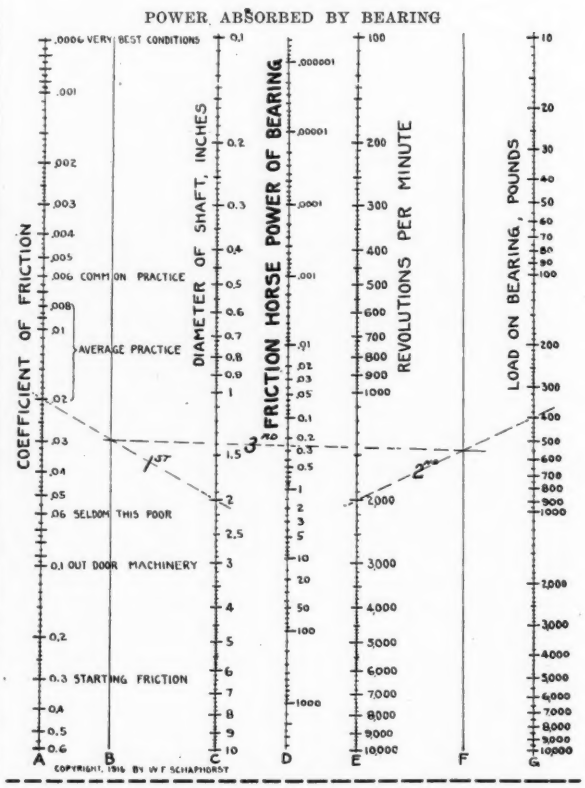
PRESSURES AT WHICH WORK IS EQUAL IN TWO-STAGE AIR COMPRESSORS. III


GAGE PRESSURE IN POUNDS.
10,000 FT. ALTITUDE
INITIAL TEMP. EACH CYL. = 60° F
ATMOS. PRESSURE = 10.07 POUNDS.
DIAMETER L.P. CYLINDERS IN INCHES.
DIAMETER H.P. CYLINDERS IN INCHES.
MACHINERY

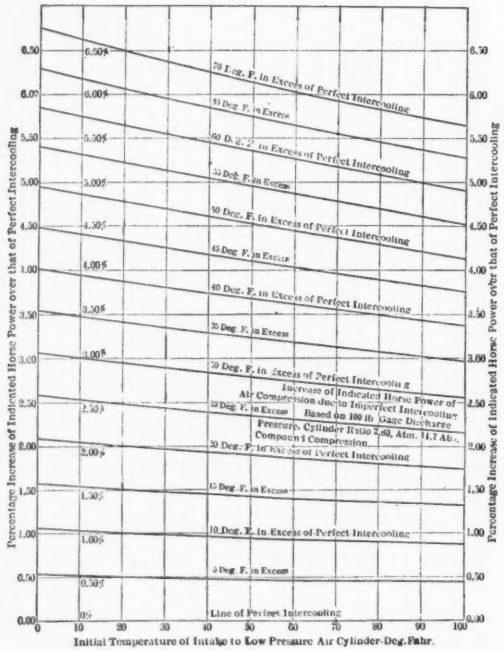
BAROMETRIC READINGS AT DIFFERENT ALTITUDES

ALTITUDE Feet	Per Cent Of Perfect Vacuum						
	100	95	90	85	80	75	70
0	30.	28.5	27.	25.5	24.	22.5	21.
68.9	29.92	28.42	26.93	25.43	23.94	22.44	20.94
416.7	29.52	28.04	26.57	25.09	23.62	22.14	20.66
767.7	29.13	27.67	26.22	24.76	23.30	21.85	20.39
1122.1	28.74	27.30	25.87	24.43	22.99	21.56	20.12
1486.2	28.35	26.93	25.52	24.10	22.68	21.26	19.85
1850.4	27.95	26.55	25.16	23.76	22.36	20.96	19.57
2224.5	27.55	26.17	24.80	23.42	22.04	20.66	19.29
2599.7	27.16	25.80	24.44	23.09	21.73	20.37	19.01
2962.1	26.77	25.43	24.09	22.75	21.42	20.08	18.74
3369.5	26.38	25.06	23.74	22.42	21.10	19.79	18.47
3763.2	25.98	24.68	23.38	22.08	20.78	19.49	18.19
4163.3	25.59	24.31	23.03	21.75	20.47	19.19	17.91
4568.3	25.19	23.93	22.67	21.41	20.15	18.89	17.63
4983.1	24.80	23.56	22.32	21.08	19.84	18.60	17.36
5403.2	24.41	23.19	21.97	20.75	19.53	18.31	17.09
5830.2	24.01	22.81	21.61	20.41	19.21	18.01	16.81

POWER ABSORBED BY BEARING

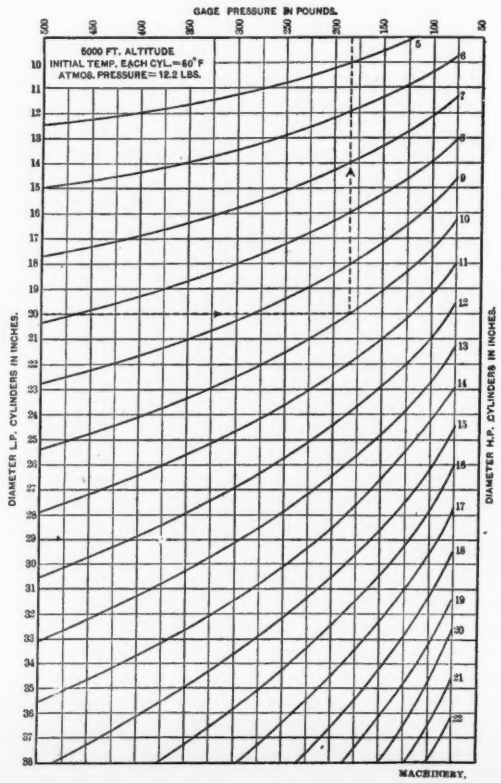


INCREASE OF INDICATED HORSEPOWER OF AIR COMPRESSION WITH PARTIAL INTERCOOLING


70 Deg. F. in Excess of Perfect Intercooling
65 Deg. F. in Excess
60 Deg. F. in Excess of Perfect Intercooling
55 Deg. F. in Excess
50 Deg. F. in Excess of Perfect Intercooling
45 Deg. F. in Excess
40 Deg. F. in Excess of Perfect Intercooling
35 Deg. F. in Excess
30 Deg. F. in Excess of Perfect Intercooling
Increase of Indicated Horse Power of Air Compression due to Imperfect Intercooling Based on 100 lb. Gage Discharge Pressure, Cylinder Ratio 2.80, Atm. 14.7 Abs., Compound Compression
25 Deg. F. in Excess
20 Deg. F. in Excess of Perfect Intercooling
15 Deg. F. in Excess
10 Deg. F. in Excess of Perfect Intercooling
5 Deg. F. in Excess
Line of Perfect Intercooling
Percentage Increase of Indicated Horse Power over that of Perfect Intercooling
Initial Temperature of Intake to Low Pressure Air Cylinder-Deg. Fahr.

—R. S. Howard in Compressed Air Magazine.

PRESSURES AT WHICH WORK IS EQUAL IN TWO-STAGE AIR COMPRESSORS. II



JAS G. G. ROSS, successor to Ross & Taggart, has been appointed New York manager for Farnsworth Co., Conshohocken, Pa.

THE NATIONAL PIPE BENDING Co., New Haven, Conn., announces the recent death of its president, Frank Lewis Bigelow.

W. H. RIPLEY, formerly with the Griscom-Russell Co., has been appointed New York sales agent, for the Nashua Machine Co., Nashua, N. H., to succeed the late W. E. Van Keuren.

COSTING $15,000,000 WHEN completed, the Hotel Commonwealth in New York City, will contain nearly twice as many rooms as any hotel in existence at the present time, a total of 2500, ranging in price from $1.50 per day (with bath) upwards. The Commonwealth will occupy an entire block-front and rise to a height of 28 stories. Built upon a cooperative plan, it will be owned by approximately 100,000 shareholders, no one of whom may subscribe for more than 10 shares of stock.

Club privileges are one of the most attractive features of the Hotel Commonwealth. The great hostelry will merge hotel and club life, and shareholders will be entitled to the advantages of both. Besides, they will share out of the net earnings in dividends and rebates upon expenditures for food and lodging and will be entitled to discount on purchases at New York stores through the shopping bureau.

The entire ice-making and cold storage equipment for the Hotel Commonwealth will be installed by the Carbondale Machine Co., who will supply two or three great refrigerating machines aggregating about 150 tons. These machines will be operated from a power plant, cooling salt water brine which will circulate through coils in the refrigerators, taking the place of ice for maintaining an excessively low temperature. Their aggregate capacity will be about 40,000 cu. ft., great enough to supply a town of from 10,000 to 15,000 persons.

W. J. Hoggson will have charge of the erection of the Hotel Commonwealth. Charles H. Ingersoll, the watch manufacturer, is president of the corporation. H. L. Merry, famous in hotel circles as manager of some of the country's greatest hotels, will manage the Commonwealth.

Books and Catalogs

ELECTRICAL MACHINERY, by Terrell Croft, 317 pages, 302 illustrations; first edition, 1917; New York; price, $2.

To anyone in the least acquainted with the writings of Terrell Croft, mention of the merits of this book is hardly necessary, particularly as regards its adaptation to the needs of the practical man. Only those theoretical principles conducive to a thorough understanding of the subject considered have been introduced and then only without the use of difficult mathematics thus enabling anyone having a knowledge of English to obtain the meat from this text with the expenditure of a minimum of effort. The subject of design has been eliminated entirely. The bulk of the volume deals with the installation, operation and care of alternating-current and direct-current generators and motors and control apparatus used in connection with such machinery.

Sections 1 to 5, inclusive, are devoted to direct-current apparatus, while sections 6 to 12, inclusive, take up the principles, construction, characteristics, installation and management of the various types of alternating-current generators and motors. Test determinations of motor-drive power requirements and motor generators and frequency changes are subjects considered in detail in sections 13 and 14.

Many clear cut illustrations, curves and tables and examples introduced serve as a means to simplify and to make the text readily understandable.

HOW TO MAKE HIGH-PRESSURE TRANSFORMERS, by F. E. Austin; 46 pages, 21 illustrations; second edition, 1917; Hanover, N. H.; price, 65 cents.

Books of a practical nature such as this, indicating to the interested student how he may best and most readily design, construct and operate electrical apparatus appear to be considerably more popular than those written along strictly theoretical lines. The theoretical side of the subject covered by this little volume has, however, in no way been overlooked, as may be seen by a perusal of the first 17 pages, where we find quite a thorough and comprehensive discussion of the theory of the transformer; with, however, a minimum amount of mathematics.

Following this, the reader will find detailed directions for the design of a 1-kw., 20,000-v. transformer and the working directions and required data for constructing a 3-kw., 20,000-v. transformer, together with an itemized account showing approximate cost of such a transformer.

In addition to this, data is also given relative to the construction of a 4000-v. transformer.

CATALOG L-10, just issued by the Lagonda Manufacturing Co., Springfield, O., gives complete description and is fully illustrative of the company's several types of boiler tube cleaners. Two types of water-driven cleaners and air or steam cleaners for all sizes of tubes are described, together with special cleaners for economizers, locomotive arch tubes, evaporators and condensers. Advantages of the Lagonda direct steam motor cleaner for heavy scale and severe operating conditions are brought out. Other Lagonda boiler room specialties are briefly described.

The company will gladly send a copy to anyone interested upon request.

STORE LIGHTING is the subject of Bulletin 29, Engineering Department, National Lamp Works of General Electric Co., Cleveland, O., containing a discussion of various types of lighting systems with suggestions and tables of particular application in store lighting problems.

THE FOLLOWING new forms have just been issued by the Ingersoll-Rand Co., 11 Broadway, New York:

Form 8006, a 20-page catalog on Imperial motor hoists and stationary motors.

Form 8212, a 4-page bulletin on Crown coal picks and core breakers.

Form 8213, a 16-page booklet on "Little David" pneumatic chipping, calking and scaling hammers.

Form 9102, an 8-page bulletin on air receivers, pressure tanks and moisture traps.

Catalogs are profusely illustrated, show tables of sizes and capacities and will be distributed free on request.

DETROIT STOKER CO., of Detroit, Mich., is sending out its last catalog on Detroit "V" Type stokers.

FOLDER Y-986 of General Electric Co. illustrates and describes electric ranges, radiators, disk stoves and other electrical appliances.

BELT BUYERS' GUIDE, a 24-page illustrated booklet embodying some practical information on the care of belting, was recently received from Chas. A. Schieren Co., New York.

FLEX-O KANT-LEAK pipe joints, made by The Durbin Co., 306 Pontiac Bldg., St. Louis, Mo., are described and illustrated in a new booklet from that company.

AN AUTOMATIC STARTER for Induction Motors, a paper presented by H. F. Stratton before the Association of Iron and Steel Electrical Engineers at Chicago, May 26, 1917, forms the body of a pamphlet from The Electric Controller & Mfg. Co., Cleveland, O.

HOISTING MACHINERY for Electrical Works is the title of a hand book just published by Shepard Electric Crane & Hoist Co., Montour Falls, N. Y. This contains 130 pages of description supplemented with cuts giving dimensional data.

THE NEW 1917 CATALOG of Hammel Oil Burning Equipment Co., Inc., Providence, R. I., describes and illustrates the Hammel standard oil burner, enumerates advantages of Hammel oil burning furnaces, and gives results of comparative tests.

FLEXIBLE METALLIC PACKING for water or oil service on outside packed plungers and particularly adapted to pumps, accumulators, presses and rams, is discussed in Bulletin No. 1 of Crane Packing Co., Chicago.

FROM THE ROBERT J. BERRYMAN CO., The Bourse, Philadelphia, we have received a pamphlet describing the company's raw water ice systems, including the Berryman low-pressure air system, high-pressure air system and Canplate water agitating system.

"ARR-AN-SEE" boiler metal treatment is the subject of a folder recently received from The Rodgers-Collins Co., Pontiac Bldg., St. Louis, Mo.

Another folder from that company describes Key Safety Hand-Hole Caps and a tool for the purpose of standardizing the hole and tightening the cap.

WESTINGHOUSE Leaflet 3819 deals with the subject of automatic voltage regulators for direct-current generators, in regard to operation, construction and accessories.

PRACTICAL ENGINEER

Trade-mark, Reg. U. S. Pat. Off.

PUBLISHED THE FIRST AND FIFTEENTH OF EACH MONTH

SEMI-MONTHLY

Subscription price in advance in the United States, Mexico or united possessions, $1.00 a year.

In Canada, subscription price, $1.75 a year.

Foreign Countries, subscription price, $2.50 a year.

Address all letters and make all checks and money orders payable to Technical Publishing Co., 537 S. Dearborn St., Chicago, Ill.

Any advertiser is invited to examine our paid subscription lists and Post Office mailing receipts at any time.

ADVERTISING RATES

Display

Full page, one year, each insertion, $66.00.

Half page, one year, each insertion, $38.50.

Quarter page, one year, each insertion, $22.00.

Eighth page, one year, each insertion, $13.25.

Front cover, $175.00 per issue.

Other specified positions, regular rate plus 10 to 50 per cent.

Stippled plates used, but no heavy, black and white plates.

Classified Rates

Per line, 30 cents each insertion.

Advertisements in this section are inserted under regular headings.

No display type allowed, but the first three words may be set in capital letters.

About nine words make a line. Minimum space sold, two lines.

Under classification "Position Wanted," advertisements not exceeding four lines will be inserted once for subscribers free of charge.

All copy should be received at Chicago office 18 days before date of publication.

Circulation of this issue, 22,000.

Technical Publishing Co.

537 S. Dearborn Street

Chicago

Position Wanted

POSITION WANTED—By man 33 years of age, good habits, with 6 years' experience with steam and gas engineering. Best of reference. Ohio license. Would prefer position in western or southern states. Address Box 482, Practical Engineer, 537 S. Dearborn St., Chicago. 8-1-1

POSITION WANTED—By a practical engineer with over 20 years' experience. Have I. C. S. Diploma. Can furnish best of references. Prefer Illinois or Missouri. Address J. M. B. Shanks, Dixon, Mo. 7-15-2

POSITION WANTED—Chief Engineer or Master Mechanic of Light & Power Co., or Factory, 12 years' experience. Age 30. Married. Present salary $1,500. Good references. East and middle west preferred. Address Kurt Illig, P. O. Box 77, Tuxedo, N. Y.

POSITION WANTED—As engineer in small steam plant not over 125 H. P., by young man. Steady and sober habits. More than 5 years' experience as engineer in grain elevator. Good mechanic. Address Box 123, Dixon, Ia. 8-1-1

POSITION WANTED—By a young man as oiler or assistant engineer in a plant where there is a chance for advancement. Three years' practical experience. Ready to start work at a week's notice. Address Wm. Wykes, 304 Palisades Ave., Yonkers, N. Y. 8-1-1

POSITION WANTED—By steamfitter with 17 years' experience at the trade. Can furnish references as to habits and ability to handle men. I am 33 years old. Married. Address J. H. D., 669 Wunderlick St., Barberton, O. 6-15-1

POSITION WANTED—By thoroughly competent man with 11 years' experience as engineer and assistant superintendent in sugar factories in Cuba, Mexico and Louisiana. Good steamfitter and machine repairman. Have had charge of 10 steam boilers and 6 ammonia compressors as day and night engineer. Can speak English, Spanish and some German. Single. 26 years old. Can furnish good references. Address Box 480, Practical Engineer, 537 S. Dearborn St., Chicago, Ill. 6-1-2

POSITION WANTED—By young man, 23 yrs. old, as fireman or oiler in ice or electric light plant in City of St. Louis. Have had one years' experience in firing and some experience in steam engineering. Address Leonard Ochs, 1536 Papin St., St. Louis, Mo. 6-1-2

POSITION WANTED—By engineer; have Ohio engineers' and boiler inspectors' licenses. Experienced with absorption method of manufacturing gasoline. Good references. Address Box 481. Practical Engineer, 537 S. Dearborn St., Chicago, Ill. 8-1-1

POSITION WANTED—Young man wishes a position as oiler or assistant to the engineer in a plant in New York City. One year practical experience. Address A. Benora, 156 Willow St., Yonkers, N. Y. 8-1-1

Help Wanted

WANTED—Resident subscription agents in the following cities: Atlanta, Ga.; Cincinnati and Columbus. Ohio; Kansas City, Mo.; Los Angeles, Cal.; Louisville, Ky.; Newark, N. J.; New Orleans, La.; Portland, Ore.; St. Louis, Mo.; San Francisco, Cal.; Washington, D. C. This is an excellent chance for a hustler who is familiar with power plant conditions, to turn his spare time into dollars. To such a one we offer a Real Opportunity. Write Subscription Department, Practical Engineer, 537 S. Dearborn St., Chicago, Ill. tf.

WANTED IMMEDIATELY—Engineer to take charge of 600 kilowatt power plant. Must be competent, energetic and get results. Give in first letter experience, references, salary desired, date you can report, photo and all necessary details. Address Galesburg & Kewanee Electric Railway Co., Kewanee, Ill. tf.

WANTED STEAM AND PRODUCER GAS ENGINEER—If any of your family need a change of climate to a higher altitude, we have an excellent opportunity for a first class operating engineer in a two thousand kilowatt producer gas and steam turbine power plant in a growing community. Give references and salary expected. Roswell Gas & Electric Co., Roswell, New Mexico. 8-15-2

WANTED—Central Station Engineer, moderate size plant in middle west. State age, experience and salary expected. Address Box 484, Practical Engineer, 537 So. Dearborn St., Chicago, Ill. 8-15-2

WANTED—In a suburb of Detroit, Mich., Assistant Engineer and Electrician; age about 35; married; one experienced in steam engineering and heating; generators and motors 110-v., D.C. Must also have a general knowledge of electric wiring and caring for telephones; one that can do all kinds of repair work around the plant. Permanent position to the right man. Give references and full information in first letter; also salary expected. Address Box 485, Practical Engineer, 537 So. Dearborn St., Chicago, Ill. 8-15-1

Wanted

WANTED—Agents on commission to sell our shaking grates. We will install grates on trial or put it to test at our expense with any grate made. Address Armstrong Mfg. Co., Springfield, Ohio. tf.

WANTED—Agents handling engine and boiler room specialties in every section for side line paying large commissions. Give experience, line carried and territory covered. Box 381, Practical Engineer, 537 S. Dearborn St., Chicago, Ill. tf.

WANTED—Marine boilers. We will pay cash awards for information that leads to a purchase by us of marine boilers of from 75 H. P. to 250 H. P. The Pittsburg Boiler & Machine Co., Pittsburg, Kansas. tf.

WANTED—For Heating Purposes—One second hand Erie City Economic Boiler or Standard Return Tubular Portable Boiler, 75 to 125 hp. with or without stack. State allowable pressure, price and location, so Hartford Inspector can inspect. Also equipment with boiler. Chicago Hdw. Foundry Co., North Chicago, Ill. 8-15-1

For Sale

FOR SALE—125 volt generators: 20 k.w. G. E. with Ideal engine, $500; 2½ k.w. Marine unit, $300; 100 k.w. Wghse. generator, $700; 60 k.w. G. E., $400; 40 k.w. G. E., $350. Send for complete stock list. Power Machinery Exchange, Jersey City, N. J. 8-15-1

Patent and Patent Attorneys

PATENTS THAT PROTECT AND PAY—Advice and books free. High references. Best results. Promptness assured. Send sketch or model for search. WATSON E. COLEMAN, Patent Lawyer, 624 F St., N. W., Washington, D. C. tf.

PATENTS—C. L. Parker, Attorney-at-Law and Solicitor of Patents. Patents secured promptly and with special regard to the legal protection of the invention. Handbook for inventors sent upon request. Washington, D. C. tf.

PATENTS—H. W. T. Jenner, Patent Attorney and Mechanical Expert, 606 F St., Washington, D. C. Established 1883. I make a free examination and report if a patent can be had and the exact costs. Send for full imformation. tf.

A. P. CONNOR, Consulting Electrical and Mechanical Engineer, Attorney-at-Law and Solicitor of Patents and Trade-Marks. Results guarnteed. 121 Carroll St., S. E., Washington, D. C. tf.

PATENTS—Send sketch for free search and reports. Books and patents and book of reference letters sent free. John S. Duffie & Co., 612 F St., Washington, D. C. tf.

PATENTABLE IDEAS WANTED—Send for three free books. R. B. Owen, 28 Owen Bldg., Washington, D. C. tf.

Technical Books

FREE ENGINEER BOOKS and power plant tools and specialties, for securing new subscribers for Practical Engineer. A dandy chance for the engineer with a little spare time to get some fine premiums. Send for free descriptive circular and terms. Subscription Department, Practical Engineer, 537 S. Dearborn St., Chicago, Ill.

Miscellaneous

ENGINEERS, DO YOU WANT to utilize your exhaust steam for heating or drying purposes without back pressure on your engine? If so, address Monash Engineering Co., 1413 Jackson Blvd., Chicago, Ill. tf

Sparks From The Advertising Pages

R. S. V. P.

This abbreviation has no relation to the rural free delivery.

It is a request suggested, though expressed differently, at the bottom of nearly every advertisement.

It is thoroughly understood by those socially inclined, because of its frequent use at the bottom of invitations.

Translated, it means, Respond, if you please.

Now, it is a foregone conclusion that every advertiser wants you to respond to his announcements, and it is also a foregone conclusion that you do well to respond, not only when in the market for equipment, but when you see something that will improve the operation of your plant. But the point we wish to bring up, is that you mention the name of the publication in which you saw his advertisement, the date of issue in which it appeared, and when a street address is given, put it on the envelope you address. This latter suggestion is given not only for the sake of the advertiser who often keeps his advertising records by the keyed address, but also for the sake of shortening the work of the post office employes.

Many of the readers of Practical Engineer are not fully acquainted with the make-up of its advertising section. As nearly as possible, all advertisements are classified according to products. For instance, should you be in the market for pumps, you will find all the advertisements of pumps grouped together. The saving of time proves the value of classification. The balance of the advertising section can be left to your leisure moments for study. It is a good thing to respond to all of the advertisements on the products interested, and draw your conclusions from the literature sent you.

It should always be remembered that it is a courtesy to the advertiser more than to anybody else when you mention the name of the publication in which you saw his advertisement.

So, Respond, if you please, but in responding do not forget the little courtesies that go with it.